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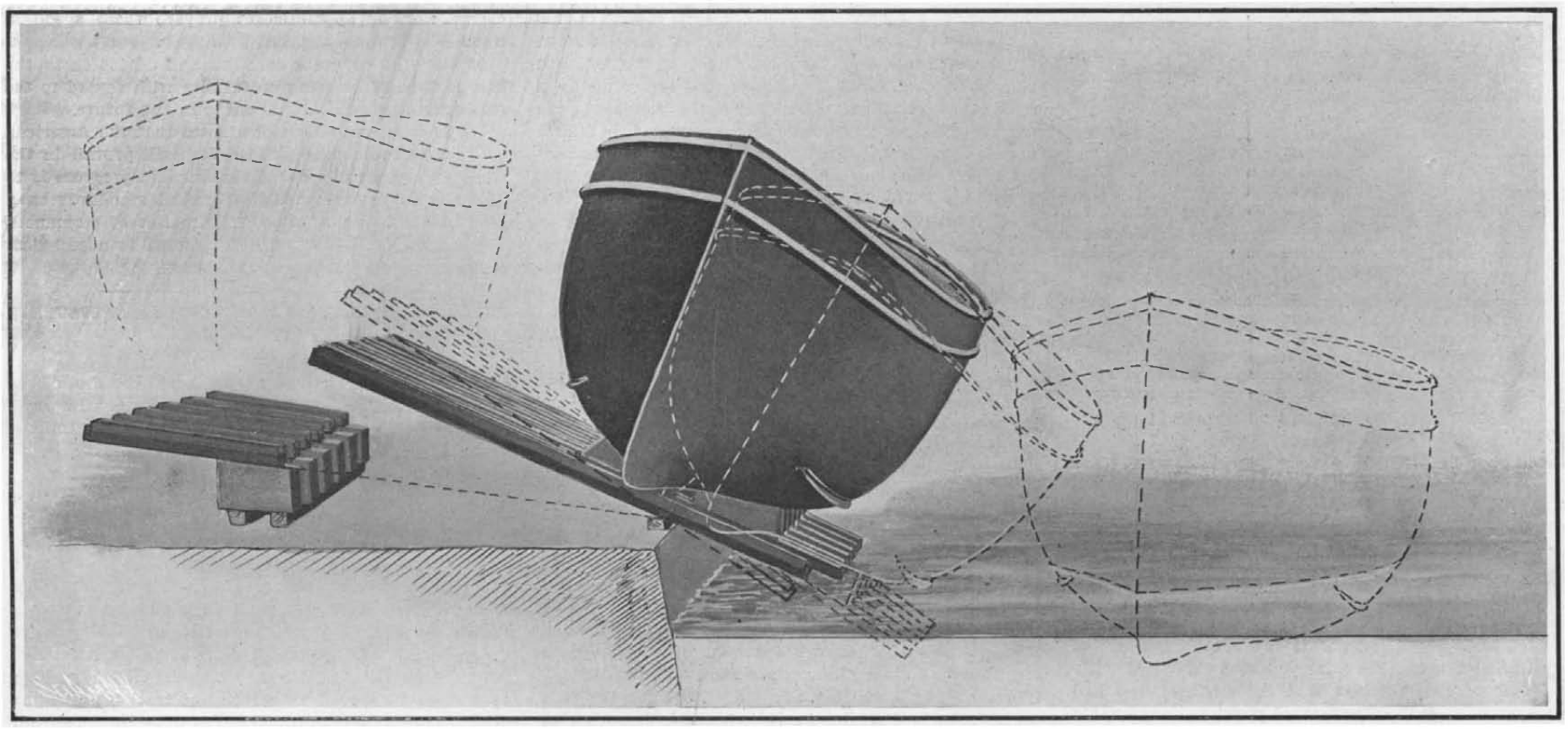
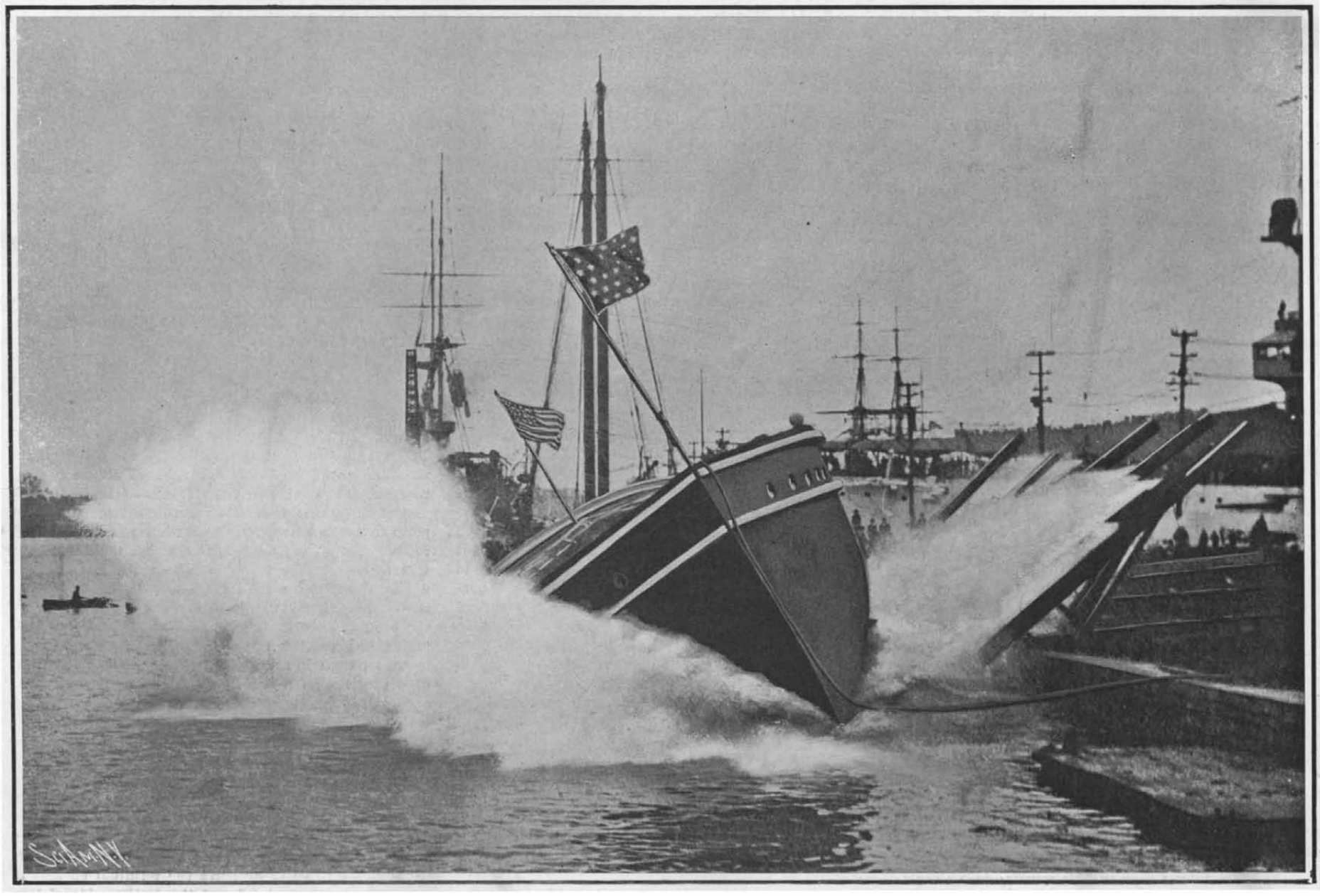
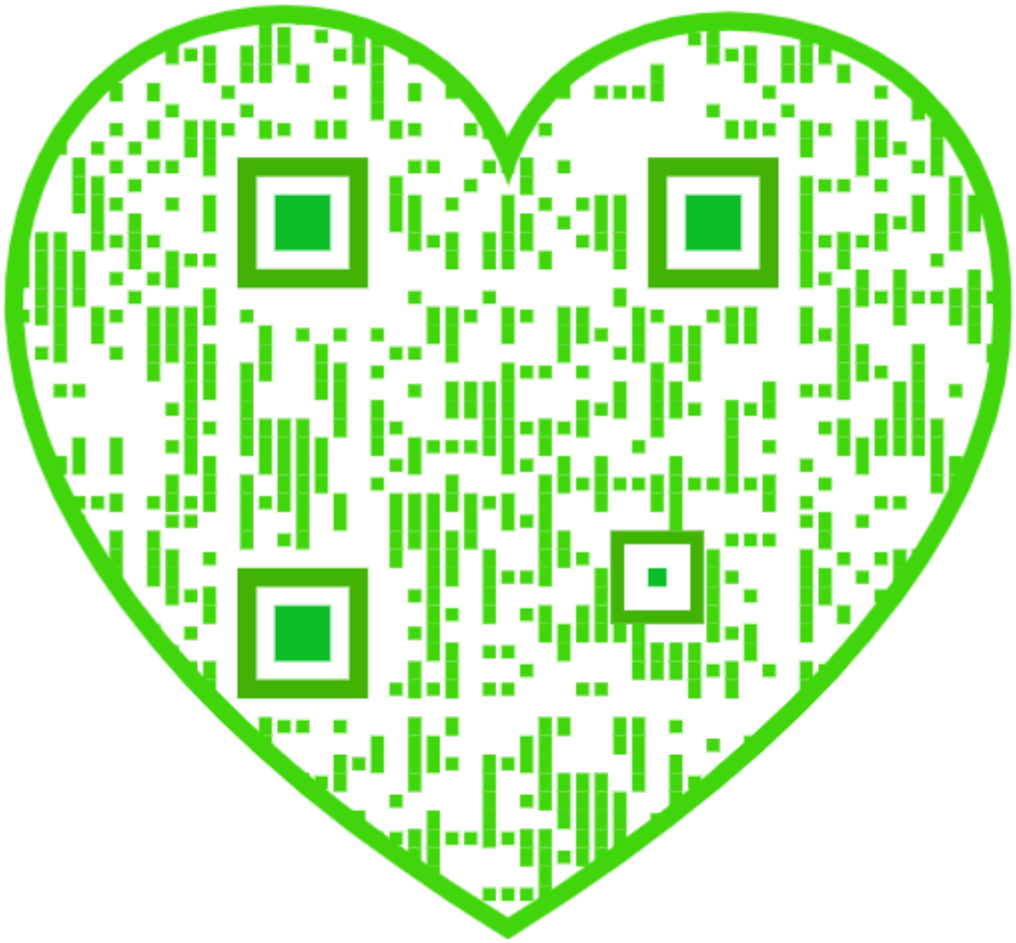


Diagram of the Launch, Showing the Lifting of the Ways as the Vessel Passed the Edge of the Dock.



View of the "Patuxent" at the Instant of Striking the Water, Showing the Tilted Position of the Launching Ways.

SIDE LAUNCHING OF THE U. S S. "PATUXENT."—[See page 122.]



SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, AUGUST 22, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PAUCITY OF MONUMENTS TO ENGINEERS.

The commemorative honors recently paid to the memory of John A. Roebling, whose name will be forever famous for the daring and skill with which he flung his beautiful suspension bridge across the East River, New York, suggest the thought that, if the winning of posthumous public memorials is reserved for those who have done not merely good service, but the most distinguished, widespread, and lasting service for their country, there should be many such memorials erected to commemorate the great engineers of the United States. We think it may be asserted without fear of contradiction that the engineer has had more to do with the phenomenal physical development of the United States than any other professional man. We mention the civil rather than the mechanical engineer first, for the reason that, in the development of a new country, it is he that blazes the way. Far in advance of the oncoming tide of civilization, he may have been found at any time during the past seventy-five years which cover the history of the railroad development of this country (to instance his greatest field of activity), solving with his transit and level and steel tape the problem of opening a highway through the prairies, mountains, and trackless forests of the middle and farther West. More often than not, he was a quiet, thoughtful man, making up in resourceful energy what he might lack in volubility and the arts of display. But where he has passed, he has left an imperishable record. As James J. Hill recently remarked, "The civil engineer is pre-eminently a man that does things"; and truly, he has done things with the hand of a Titan, as witness the 230,000 miles of railroad, freighted with a nation's wealth, with which he has covered the country. In his adaptation of means to ends, where the means were often all too scanty, he has shown the true hand of genius; for had he not broken away from the conservative methods of older and richer countries, the problem of the prairies and mountains of the West would be to-day unsolved, and we would still be speaking of the "Great American Desert."

Where, at the present writing, can we find any monument to these engineers who have made possible a railroad system which is one of the marvels of the twentieth century? Similar neglect has been shown in the broad field of mechanical and electrical engineering; whose pioneers have surely lain long enough in their graves to give an appreciative public time to determine to whom it should first erect its commemorative marbles.

We cannot be accused of being a people averse to the building of commemorative works, whether in the form of shaft, tablet, or statue; as witness the lavish hand with which the cities of the country and its battlefields have been adorned with memorials of our leading military men. Unfortunately, our work in this direction has been very much out of balance; and for one monument raised to men who have done service in the arts of peace, we may find fifty devoted to those who have gone forth to war. But perhaps the recent unveiling by the people of the city of Trenton of their statue to an engineer, whose fame was wider than any city or municipality could contain, may prove to be a suggestion that will bear fruit in the addition to the tributes to Ericsson and Holley, of others to men whose services were none the less distinguished because they were but little heralded.

INTERNATIONAL ELECTRICAL UNITS.

To secure the better definition of international electrical units and standards is the main reason for an international electrical congress, which will convene at London on October 12. Since the electrical congresses of Chicago in 1893 and of St. Louis in 1904, the subject of units and standards has been under the careful consideration of leading physicists and electrical engineers, and much experimental work has been carried on in various national and other laboratories with the object of obtaining data which would lead to the amplification and more accurate statement of the definitions adopted at Chicago. In the interval since that congress, each investigator concerned has been most anxious to introduce every possible refinement into his work, as any new decisions must be based largely on experimental evidence. At the St. Louis congress the delegates considered that the question could not be settled then by direct legislation, but should be considered by experts and taken up by a subsequent congress. First suggested for 1906, the coming congress has been twice postponed, but now, apparently, matters are in shape to enable it to consider the steps which should be taken to bring about agreement in the definition of electrical units which shall form the basis of legislation in different countries, and in the methods of constructing and employing the electrical standards necessary to give effect to these definitions. In discussing the units and standards the main question will be whether the volt or the ampere shall be recognized as the primary unit with the ohm. For as all electrical measurements are derived from Ohm's law, $I = E/R$, or the intensity of the current varies directly as the electromotive force and inversely as the resistance, if we have any two of these units we can derive the third. Now it is universally agreed that the ohm, or practical unit of resistance, shall be one of the primary units, but when it comes to the other there is a difference of opinion as to whether it should be the ampere, or unit of current, or the volt which is the unit of electromotive force. These practical units are all defined in terms of the C. G. S. or absolute system, but this is purely theoretical; and just as we refer to a certain platinum-iridium meter bar as our standard of length, so in electricity we must have certain standards that actually realize any definition adopted. Thus for the ohm there is little difficulty in realizing the definition of the Chicago congress, that the international ohm, based on 10^9 units of resistance of the C. G. S. system, should be represented by a column of mercury at 0 deg. C., 14.4521 grammes in mass, of constant cross-sectional area and 106.3 centimeters in length. But the Chicago congress also defined the ampere as the current depositing 0.001118 gramme of silver under specified conditions in a coulometer or silver voltameter, and the volt as 1000/1434 of the electromotive force of a Clark cell under standard conditions. These separate definitions of the ampere and volt, however, did not meet with universal acceptance, and in several countries other definitions legally were authorized. In the meantime the coulometer was subjected to further investigation as well as the Clark cell, while the Weston cadmium cell was developed and found superior to the Clark in several important particulars. In fact, those working with the standard cells pointed to their greater accuracy and reproducibility, and urged that the volt as thus defined be taken as the fundamental unit. In behalf of the American physicists this view was vigorously presented at a meeting of representatives from various national laboratories and bureaus of standards which was held at the Reichsanstalt at Charlottenburg near Berlin in October, 1905, by Prof. H. S. Carhart, and backed by additional arguments the claims of the standard cell will again be urged at the coming congress. While the conference at the Reichsanstalt was informal, yet it passed resolutions recognizing the ohm and the ampere as the fundamental units, and recommended that the Weston cell be adopted as the standard of electromotive force, but without any value of its E. M. F. being specified in any legislative enactment. Further, it was recommended that at each national laboratory standard ohms realizing the international definition should be constructed, while at the same time a technical commission should be appointed to prepare detailed specifications for realizing the definitions adopted by the next congress. These decisions simply presented the questions in a concrete and direct form, which has been embodied in the formal programme for the London congress.

Accordingly, this body will be concerned largely with the discussion of the following propositions:

1. That the ohm shall be the first primary unit.
2. That the ampere shall be the second primary unit.
3. That in consequence the volt shall be treated as a secondary or derived unit.
4. That the international ohm shall be defined as the resistance at the temperature of melting ice of a column of mercury of uniform cross section terminated by planes at right angles to its length 106.3 centimeters in length and 14.4521 grammes in mass.
5. That the international ampere be defined as the unvarying electrical current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0.001118 gramme per second.
6. That the international volt be defined as that E. M. F. which when applied steadily between the ends of a conductor of resistance 1 international ohm produces a current of 1 international ampere.
7. That the Weston cadmium cell be adopted as a convenient standard of E. M. F.
8. That specifications dealing with the methods of setting up mercury standards of resistance, of realizing the ampere by the deposition of silver, and of preparing standard cells be issued with the authority of the congress, and that for this purpose a technical commission be appointed to prepare these specifications.
9. That the congress consider and advise as to the best method of securing uniformity with regard to the fundamental electrical standards in the future.

While it is earnestly to be hoped that the American view of the volt and standard cell will prevail in the congress, yet in any event considerable progress is to be expected toward putting electrical standards on a more accurate basis, even if the matter of permanent definitions is not settled, but referred to a technical commission for further investigation.

IMPROVEMENT OF NEW YORK-NEW JERSEY SUBURBAN SERVICE.—II.

ERIE RAILROAD.

In our issue of June 20 we published the first of the present series of articles on the important improvements which are being made in the railroad terminals in Jersey City and the approaches thereto, with a view to facilitating the movement of the ever-increasing number of trains, both suburban and long-distance, which make use of these terminals. In that article, which dealt with the improvements of the Delaware, Lackawanna & Western Railroad, it was shown that, in addition to an entirely new terminal and ferry-house, the company had built an additional two-track tunnel through Bergen Hill, parallel to its old tunnel, thus doubling at once the capacity of its tracks at that point. The Erie Railroad, which has been perhaps even more hampered by scarcity of tracks, is making larger additions than the Lackawanna Railroad; for it is now engaged in excavating a huge four-track open cut through Bergen Hill, adjoining and parallel to its existing two-track tunnel. Bergen Hill, which is really a continuation of the Palisades of the Hudson, lies about three-quarters of a mile to the west of the Hudson River, and at the point where it is pierced by the present Erie tunnel it averages about 100 feet in height and 4,000 feet in width at track level. Of late years the congestion at the Erie tunnel has become intolerable. It is due to the fact that upon its two tracks has to be carried, in addition to an unusually heavy suburban traffic, both a large through express and a freight traffic. The construction of the new four-track open cut and the rearrangement of the approaches thereto form part of an extensive plan of improvement which will include eventually a new terminal building and ferry-house.

At the present time the two-track tunnel, during the morning and evening rush hours, is reserved exclusively for the use of passenger trains, while during the rest of the day it is used by both freight and passenger trains. The traffic of the Erie road converges to the Jersey City terminal from six different branch lines, which merge to the west of Bergen Hill in three groups of two lines each. The New York, Susquehanna & Western Railroad and the Northern Railroad of New Jersey approach from the north; the main line of the Erie and the New Jersey & New York Railroad come in from the west; and the Greenwood Lake division and the Newark branch from the south. The only possible arrangement by which the traffic of these six roads could be accommodated through the one tunnel was to operate the two tracks in the same direction during the morning rush hours, and allow no trains to travel through the tunnel in a westerly direction. In the evening the difficulty is solved by doubling up the trains and placing two locomotives at the head of them, for the trip through the tunnel. When the point of divergence is reached, the trains are cut in two, and each locomotive picks up its respective part of the train. When the open cut is completed, its four tracks will be devoted exclusively to passenger trains, and the freight traffic will be handled through the existing tunnel. It is proposed to operate three of the new tracks in one direction, and the fourth in the opposite direction during the rush hours, and to operate two of the tracks in each direction during the hours when traffic is lighter. Under this arrangement three trains will be able to enter or leave the terminal abreast of each other, and the tracks on the farther side of Bergen Hill have been so rearranged that these trains will be able to proceed to their respective destinations without interfering with each other, or with the inbound trains coming over the fourth track.

The rearrangement of the tracks west of Bergen Hill provides for a system of separated crossings, so arranged that none of the tracks intersect at a common level. The four tracks on emerging from the open cut are carried below the Delaware, Lackawanna & Western Railroad and beneath Tonnele Avenue. Here they diverge into six tracks, one inbound and one outbound for each of the three groups of trains. From Tonnele Avenue the Susquehanna tracks rise on an embankment and cross the west-bound main line and west-bound Newark branch. They are carried on a viaduct across the freight tracks of the Erie Railroad, after which the two tracks run side by side to the point at which the Susquehanna and the Northern Railroad trains separate. The west-bound tracks of the Erie main line pass under the passenger and freight tracks of the Susquehanna. The Erie main line east-bound track passes below the Susquehanna freight tracks, and then both these tracks rise on separate embankments and run parallel on a bridge over the west-bound Newark branch, and the Newark branch freight connection. The two tracks then descend on an embankment and run parallel to a point at which the main line trains and those of the New Jersey and New York lines diverge. Similar skill has been shown in working out the arrangements of the other lines that converge to the open cut through Bergen Hill.

From the above description it will readily be understood that the construction of the new layout of the tracks called for some heavy and costly work, involving a large amount of embankment and bridge work. Altogether 8.4 miles of new double track have been constructed and 8.7 miles of the existing double track have been abandoned, the last named, however, being very largely available for future freight traffic. Included in the bridge work is the construction on one of the new lines of a two-track drawbridge with 449 feet of girder approaches and a draw-span measuring 339 feet over all. The construction of the new embankments calls for the moving of over half a million cubic yards of material, part of which will come from the big cut, and part will be taken from "borrow pits" at the side of the embankment.

Although the new four-track system through Bergen Hill has been spoken of as an open cut, it is not strictly such, since it contains four short tunnels where the tracks pass beneath the various avenues and streets. Going west the first tunnel, below Hudson County Boulevard, is 190 feet in length. The next, beneath St. Paul's Avenue and Bevan Street, is 285 feet in length. Following that is a tunnel 235 feet long below Summit Avenue, while the fourth tunnel, the longest of all, is 580 feet in length and lies below Central and Hoboken Avenues.

Several considerations led to the choice of an open cut in preference to a continuous tunnel. First, there are the constructional difficulties attending the excavation of a tunnel wide enough to accommodate four tracks, and the extra cost as compared with an open cut; secondly, there are the advantages of comfort for the passenger and convenience of operation; and, lastly, there is the great value of the crushed trap rock of this vicinity for use as ballast, and for making concrete. The excavation of the cut involves the taking out of 114,000 cubic yards of earth and 420,000 cubic yards of rock, and the four tunnels call for 79,000 cubic yards of rock excavation. The earth excavation is being used for building the embankments upon the Hackensack meadows, and the rock is carried to a large crushing plant, erected a little to the west of Bergen Hill, where an enormous pile of the crushed material has already been collected.

The new improvements are being carried out on such an extensive scale that they will be more than sufficient to take care of the present traffic, and will allow for an extensive growth in the future. One important result will be that the New York, Susquehanna & Western, which at present makes use of the Pennsylvania terminal station in Jersey City, will in the future run its trains into the Erie terminal.

SCIENCE AND THE SCHOOLBOY MIND.

BY H. W. HORWILL.

If the study of one's failures is part of the preparation for future success, teachers of science would do well to ponder the significance of the amusing examination answers that occasionally get into print. These are ordinarily published for the entertainment of the general reader, and they certainly serve that purpose well. But they may easily be made a means of edification as well as diversion. They often point to some flaw in methods of teaching, and suggest in what direction there is need for reform.

Of late years many educational authorities have shown a tendency to minimize the use of textbooks and trust to oral instruction. But the risk attached to teaching by word of mouth is clearly seen in numerous instances of a pupil's confusing some important word with another that resembles it in sound. Here are some examples: "The equator is a menagerie lion running round the earth." "The earth's climate is the hottest next the creator." "Sound effects the oratory nerves." "The blood is putrefied in the lungs by inspired air." A confusion with the word "rotation" is of course responsible for the definition of the axis of the earth as "an imaginary line on which the earth is supposed to take its daily routine." Scientific teaching offers a large number of opportunities for such confusions when technical terms reach the mind through the ear only, and not also through the eye. Really, one cannot be hard on a child who tells us that food passes through the "elementary" canal, or that one of the brightest stars is called "Juniper."

When a word that is in common use has a special scientific meaning, it is always necessary for the teacher to take pains to avoid a misconception. Unless he is warned against the error, it is hard for a pupil to get out of his mind the idea that "shed" in "watershed" must point to some kind of a building. Thus we get such examination answers as these: "A watershed is a place where there is water and rocks overhead that form a shed." "A watershed is a house between two rivers, so that a drop of water falling on one side of a roof runs into one river, and a drop on the other side goes into the other river."

In a great many instances the root of the trouble is evidently an imperfect explanation of the fact or phenomenon described. When an examination candidate declares that "a parallel straight line is one which, when produced to meet itself, does not meet," how is it possible to escape the conviction that an attempt has been made to load the memory with a definition without the least endeavor to get hold of its meaning? Such an answer reflects far more seriously upon the teaching received than does the statement that "parallel straight lines, even if produced to all eternity, cannot expect to meet each other." In the latter case, in spite of the confusion between the words "infinity" and "eternity," there is at any rate a fairly substantial idea of what parallel lines are. Mere rotework teaching, again, would account for the declaration that "air usually has no weight, but when placed in a barometer it is found to weigh about fifteen pounds a square inch." Clearly, there can have been little laboratory teaching in the school from which came the answer that "if a small hole were bored in the top of a barometer tube, the mercury would shoot up in a column thirty feet high," though one cannot understand how any small boy with ordinary curiosity could have refrained from attempting to verify such a fascinating statement by independent experiment. The lazy mind, catching up vaguely something it has heard while escaping the least exertion of thought, is further illustrated in the startling proposition that "things which are equal to each other are equal to anything else."

A subtle danger, to which even the most efficient teacher is sometimes exposed, is that of making an unimportant feature so interesting that the really significant matter is overlooked. A specimen case is the answer that "gravity is chiefly noticeable in the autumn, when the apples are falling from the trees." Evidently the picturesque story related of Sir Isaac Newton had impressed the mind to the obscuring of the truth involved. And this child was by no means a mere repeating parrot, for he had reflection enough to reach, independently of his teacher's assistance, the conclusion that, if it is in falling apples that gravitation is chiefly illustrated, the autumn is the time of year when it must be most frequently visible.

Some of the funniest answers reported are, after all, better testimonies to the quality of the teaching than many replies which conform more nearly to the phraseology of the books. The following account of the law of gravitation is not quite a model of scientific expression, but it certainly shows that the examinee has been thinking the matter out for himself and not without success. "If the earth was to have no gravity, and if we climbed to the top of a hill and jumped a little above the top, we would stick fast in the air, and thus there would be an end to our existence; or if there was no gravity, then some of the furniture in our houses would be above the floor of the house, and thus if we let a thing fall it would not fall to the ground, but stick just in the place where it fell out of our hands." Here, too, is a piquant illustration of the law that liquids expand when heated: "If a kettle is placed on the fire with water in it, and all means of ventilation stopped up, the kettle would bounce off the fire from the great force which was made inside it which it wanted to let escape." Happily many instances might be given in disproof of the frequent accusation that present-day school teaching stifles originality. The mental activity with which a pupil, when at a loss for an answer, will construct one out of his own head is often such as gives promise of conspicuous distinction if once the habit of diligence could be formed. It is not mere adroit evasion to say that "the difference between water and air is that air can be made wetter, but water cannot." No less thoughtful was the lad who in an essay on "The Elements" said: "Air is the most necessary of all the elements; if there was no such thing as air, I would not be writing this essay now; also there would be no pneumatic tires, which would be a sad loss." A mind capable of detecting the subtlest analogies of nature must surely have been possessed by the boy who wrote: "Mushrooms always grow in damp places, and so they look like umbrellas." We may be sure that it was not from a San Francisco school that there came the assertion that "the probable cause of earthquakes may be attributed to bad drainage and neglect of sewage." At any rate, the zeal for sanitation shown thus early ought to guarantee a diligent career as health inspector. A particularly curious instance of independent but inaccurate observation is this answer to a question respecting the differences between steamers and sailing vessels: "A steamer cut or part the water aside; but with a sailing vessel it is not the case, for it sail up and down on the waves and billows." This answer, possibly, is due in some measure to the pictures—advertisements of steamship companies and the like—which represent steamers as aggressively cutting their way through the water, as compared with the quieter representations of the progress of sailing ships. Perhaps similarity with the domestic uses of electricity is accountable for the statement that "electricity and lightning are of the same nature, the only difference being that lightning is often several miles in length, while electricity is only a few inches."

SCIENCE NOTES.

The quantity of sulphuric acid in mine water varies according to the district and condition of the mine. Some mine water has been found to contain only a few grains, while the water in other workings often contains over 100 grains per gallon.

Some experiments have been recently carried out which appear to show that the sea water round the coast of Ireland possesses a richness in radium not hitherto expected. This result has been extended by measurements made on samples of water collected between Madeira and England, and also on water from the Arabian Sea. In a paper recently delivered it is shown that the deep-lying sediments of the ocean are exceptionally rich in radium. The materials dealt with were partly from the "Challenger," partly from the "Albatross" collections. Some globigerina ooze from the west coast of Ireland was also treated.

Dr. H. F. Schmidt, of Berlin, has completed an exhaustive study of the effect of Roentgen rays on the development of amphibia. Thirty-five axolotl eggs were placed in a shallow dish in water and exposed to the rays for half an hour. Thirty-one eggs from the same animal were simultaneously exposed to the air of the laboratory, in a similar dish of water, but shriveled from the Roentgen rays. The two batches of eggs were then kept in identical conditions and observed from time to time. When the larvæ appeared the effect of the rays was strikingly apparent, the larvæ from the eggs exposed to the Roentgen rays being much smaller than the others and curved in a peculiar manner. Only a small percentage of the exposed eggs hatched, and all the larvæ which came from them died within a few days. The thirty-one eggs which were not exposed to the rays produced as many larvæ, all of which were alive and very active after the death of the others. Microscopic examination of the larvæ killed by the rays showed that the membraneous envelope of the brain was almost destroyed and that the brain and spinal cord were seriously injured. Similar effects of radium rays on the eggs and larvæ of frogs have been observed by other experimenters.

THE CURRENT SUPPLEMENT.

A paper by Mr. William P. Durtnall entitled "The Generation and Electrical Transmission of Power for Marine Propulsion and Speed Regulation" opens the current SUPPLEMENT, No. 1703. The city of Gary, Ind., is installing a sewer system which presented unusual difficulties to the engineer because of quicksand. A novel method of draining the wet excavation instead of emptying it in the usual way is described by Mr. C. M. Ripley. Mr. R. B. Woodworth's paper on "New Shapes of Steel for New Uses" is concluded. An important development which will exercise a far-reaching influence upon the commercial prosperity of Egypt, and which would tend to increase the agricultural prosperity of the country, has been effected by the completion of the first section of the Libyan Desert railroad. The English correspondent of the SCIENTIFIC AMERICAN describes and illustrates the work in detail. "Darwin and After Darwin" is the title of a paper by Prof. Henry Edward Crampton in which the newer discoveries in biology are simply explained. The twenty-fourth installment of Prof. Watson's elements ol electrical engineering deals with electrochemistry. In an article entitled "The Respiration of an Inland Lake," Prof. E. A. Birge describes the part played by the absorption and distribution of oxygen in small bodies of inland waters.

DRY FARMING IN SEMI-ARID DISTRICTS.

BY W. FRANK M'CLURE.

A great deal of attention is being attracted at this time to a system of agriculture known as "dry farming," which is being successfully used in the semi-arid districts of Colorado and other Western States in place of extensive schemes of irrigation. By "semi-arid" is meant a territory in which the annual rainfall is less than twenty and more than eight inches. By dry farming, many thousands of acres which, on account of their location, could never be reached by irrigation ditches are reclaimed. Some of this acreage has long been styled "grazing lands," and considered useful for nothing else.

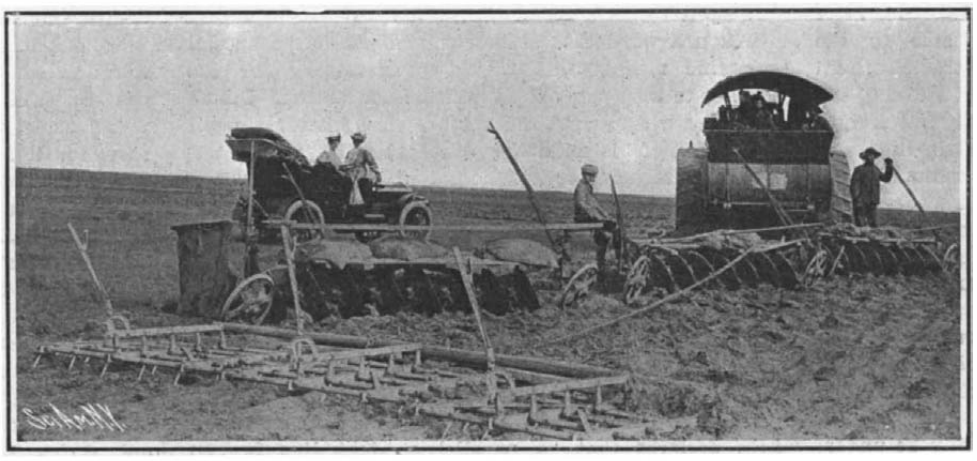
"Dry farming," briefly stated, consists in so preparing the soil in semi-arid regions that it will catch what little annual rainfall there is, and store it within reach of the roots of the plants to be grown. This, as might be supposed, requires a firm, solid foundation beneath the soil. The soil above is kept firm and loose and acts as a mulch, keeping the moisture from escaping into the atmosphere, much as a brick or plank keeps the ground directly under it moist even in a beating sun. With such preparation of the soil, grazing lands will often yield as high as 40 to 50 bushels of wheat to the acre, or more than the yield of the Eastern States, where the natural rainfall is adequate.

The last two years have witnessed the greatest progress in the new plan of reclamation. Not only is "dry farming" being extensively employed in Colorado, Kansas, and Nebraska, where it was first introduced, but in eastern Washington, Oregon, Wyoming, Idaho, and Utah, where heretofore great tracts of prairie land could, in many instances, be bought as low as fifty cents an acre.

The first experiments in this line date back more than a decade. The founder of the method is Prof. H. W. Campbell of Nebraska, under whose personal direction to-day are some large model farms in the West, illustrating the marvelous accomplishments of "dry farming." Five years ago the Department of Agriculture began to lend its assistance in the matter, carrying on investigations as to the localities in which "dry farming" will bring the best results. The department is also searching in many parts of the world for kinds of alfalfa and wheat and other plants which will yield the largest returns with a rainfall of less than twenty inches.

As to land, it may be stated that high plateaus or rolling hills afford a better supply of rain to be stored by "dry farming" methods than do the valleys, and they are therefore usually chosen first.

The accompanying photographs were made at Longmont, Colorado, where many thousands of acres are under cultivation. This State is taking particular interest in development along these lines. Within the past year Gov. McDonald called together a congress of "dry farmers." Many ranches are being broken up to give place to the new system of farming, for it does not pay to raise cattle at the present prices at which this land is selling. In fact, much of the upland country is being turned into a veritable garden.



A Smoothing Harrow Follows the Plow. Much Harrowing is Essential to Success in Dry Farming.

The first operation in the preparation of the soil is plowing. This must be deep. A disk or a mold-board plow may be used, depending on the character of the ground. One object of the deep plowing is to provide an adequate reservoir for the storage of the rainfall. Gang plows with twelve to sixteen plowshares in each are a common sight. These plows are drawn by traction engines, as shown in the photograph. Steam plowing helps out wonderfully in this work. In some of the Western States it would be out of the question to secure sufficient men and teams to accomplish the plowing of the hundreds of thousands of acres annually being reclaimed by "dry farming." Steam plowing costs less than half as much as plowing with teams. It is not unusual for one plowing outfit to turn 3,000 acres of sod into cultivated land in one season. Two men are needed to operate the engine, besides a teamster and team for hauling fuel.

A sub-surface packer follows the plow, drawn by the same traction engine as the plow. This packer is similar in shape to a disk plow, except that it has ten wheels. These wedge-shaped wheels or disks are 18 inches in diameter, and are arranged vertically on a shaft six inches apart. The object of the sub-surface packer is to firm the soil. A smooth roller if used for this purpose would have the effect of packing the surface soil rather than that of the sub-surface. The wheels of the packer, however, are so arranged that they firm the soil in the lower portions of the furrow,

Breaking the Ground for Dry Farming. The Work is Done on a Large Scale, and Machine Power is Necessary. One Plowing Outfit Can Prepare 8,000 Acres of Sod in One Season.

Hauling Grain to Market from the Dry-Farming Districts Around Longmont, Colorado.

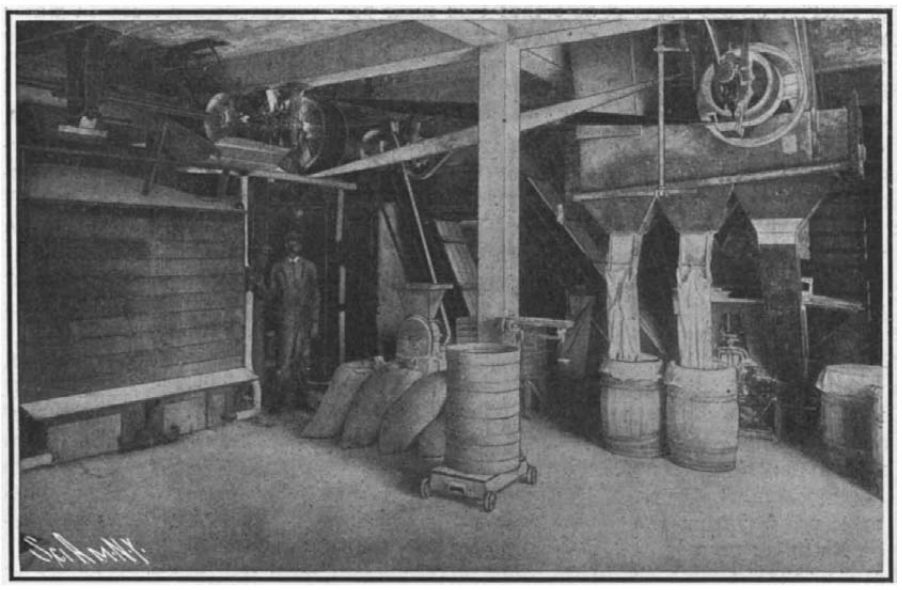
restoring capillarity where plowing has arrested it. A smoothing harrow next follows, leaving a pulverized layer on top, which prevents the moisture from below from reaching the surface and evaporating.

The constant care and working of the soil on which the crops are to be raised is said to be equally important with the rainfall itself. The pulverized ground must not be allowed to pack or break in any event. To avoid this, the harrow is run over it after each rain. The working of the soil begins several months before seeding, and must also be continued after seeding.

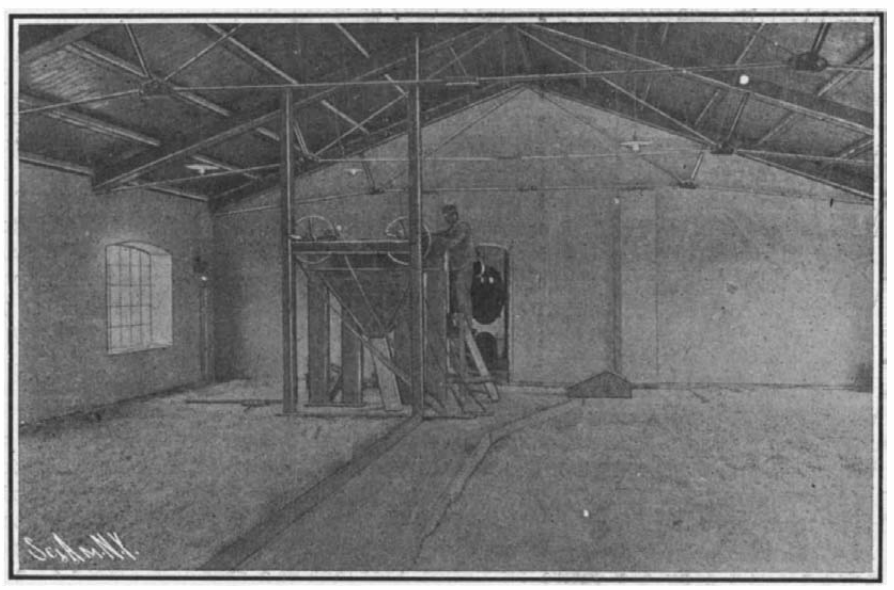
A great many people, cultivating their land under the new system, aim to raise but one crop from the same ground in two years. They divide this land into two equal parts, and use one part for crops one year, and the other the next. This admits of what is known as "summer culture" on the part not in use, and the storing of a season's rains in the soil reservoir. Again, it may be feasible to allow the land to produce crops for two years, and alternate one year of "summer culture." Where crops are planted every year, plowing must quickly follow the operation of harvesting, the aim being to save all possible moisture in the ground and simultaneously prepare the soil for the next rains.

It is confidently expected that the time will come when land on which but a ten-inch rainfall is now recorded will be made to blossom as the rose. This will be accomplished by further advances in scientific discovery. At present, districts having less than fourteen inches rainfall are not regarded as profitable. An educational movement for the scientific study of "dry farming" has already been talked of. Not all attempts at "dry farming" are a success, nor will be until the mass of the people using it understand the principles on which it must be carried out. The rainfall varies in different years, and this emergency must be met in a scientific way. Conditions differ also in different localities.

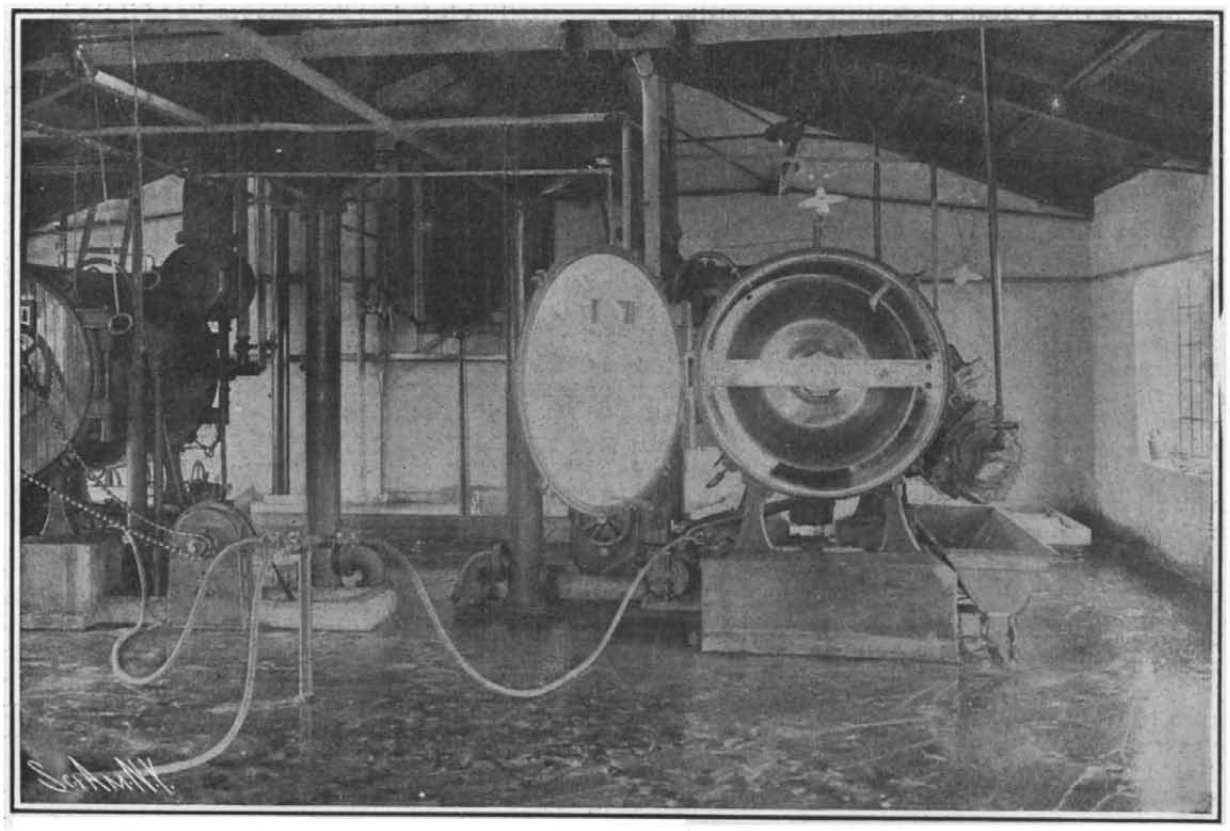
The establishment of more government experiment stations will greatly assist different sections. Several are to be established, it is understood, this year. At Cheyenne, Wyoming, the Board of Trade not long ago established an experiment station, assisted by the government and the railroads. It was here found that, although Cheyenne is at an elevation of 6,000 feet above sea level, wheat, rye, barley, oats, alfalfa, field peas, and sugar beets can be grown profitably. As a result of the experiments the ranchmen in Wyoming are buying thousands of dollars' worth of farming machinery, and are breaking up large acreages and sowing alfalfa and other grasses and grains. Ranches are also being sold for colonization purposes.



Part of the Plant Where Milk Powder is Ground and Sifted to the Consistency of Wheat Flour Ready for Packing.

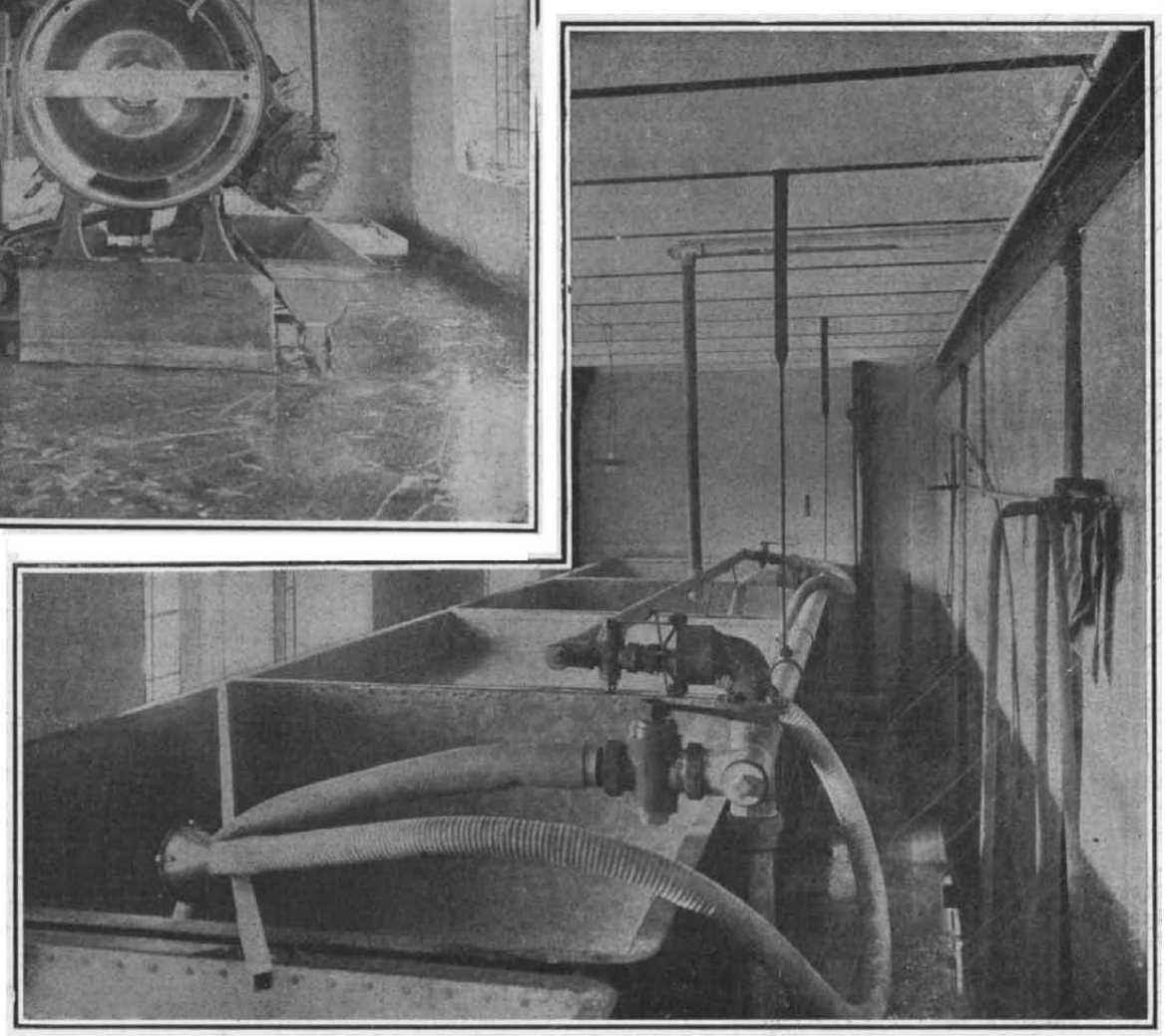


Cooling the Dry Milk and Feeding the Conveyor Leading to the Milking Plant. The Powdered Milk on the Floor is Yellow in Color and Brittle in Texture.



The Milk-Drying Room, Showing the Exsiccator Devised by Dr. Ekenberg for Drying the Milk under Vacuum with Exhaust Steam.

One exsiccator is shown open, upon the interior nickeled surface of which the milk powder is deposited. The supply of milk from the feed tanks is maintained through flexible pipes from the standpipe in the center.



The Tanks into Which the Milk is Pumped from the Delivery Room.

THE EKENBERG PROCESS FOR MANUFACTURING DRIED MILK.

THE EKENBERG PROCESS FOR MANUFACTURING DRIED MILK.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Some five years ago we briefly referred in the pages of the SCIENTIFIC AMERICAN to a lecture delivered before the Royal Academy of Agriculture in Stockholm by Dr. Martin Ekenberg, the eminent Swedish scientist, relative to the production of dried milk, in which he tersely described a system he had then recently evolved for the production of this substance upon an entirely new basis, and in which the constituents of the liquid even when condensed were perfectly retained. Since that date several improvements in the process have been effected, and at the present time there are several factories in Sweden and other countries where the production of the milk powder is being carried out upon an extensive commercial scale.

While there is no food which can take the place of milk in its various uses, there is at the same time no dietary article which is more difficult of distribution, as it is extremely sensitive, and liable to rapid changes and sour fermentations. The reason is that the liquid is composed of 88 per cent of water, in which the solid food substances are dissolved and suspended; and among these latter substances there is one most subtle class, i. e., the albumenoids. It is clear that the great amount of water present renders the milk remarkably susceptible to the propagation of bacteria, while at the same time its bulk militates against cheap and easy transportation.

Numerous efforts toward preserving the solid sub-

stances present by the elimination of the water have been made since the early years of the past century, but the difficulties encountered in entirely extracting the water and the inefficient mechanical means then available were such that the attempts toward producing powdered milk were perforcedly abandoned, and the production of the milk in a condensed form perfected. In this process the milk is converted into a thick liquid which, especially in the presence of cane or beet sugar, has keeping qualities sufficient to render it an article of commerce easily transportable. But although the milk is considerably decreased in bulk by the process of condensing, exploration in the tropics, and long sea and land expeditions, when all requisite food supplies have to be carried from the very start, rendered it apparent that a further diminution in the bulk was desirable, not only in regard to weight but also in order to obtain a better keeping quality, since it is imperative with the condensed product that the can in which it is carried should be absolutely air-tight. Furthermore, condensed milk is somewhat monotonous as a daily food owing to its extreme sweetness. Consequently the old question of reducing the fresh milk to a dry powdered form again impressed itself upon scientists, and numerous experiments to overcome the obstacles which had proved insurmountable to the pioneers in this direction were carried out, among them being Dr. Ekenberg's.

In these renewed efforts the investigators were appreciably assisted by the entire revolution that had taken place in the dairy industry by the introduction of the centrifugal skimming or separating machine, which rendered the practical utilization of the resultant skimmed milk a question of vital importance, since the milk, being deprived of the greater proportion of the cream, was rendered unmarketable in the usual manner, so that it became somewhat of a by or waste product. But at the same time, although the separator made it possible for inland dairies, whence transportation of the raw fresh liquid was difficult, to produce a salable and remunerative article in the form of butter, yet the bulk of the milk—skimmed milk—containing the most valuable parts from a physiological point of view, was left behind.

The operation of extracting the water and converting the milk into a powder appears at first sight to be somewhat simple, but in such a process care must be observed that the resultant product has none of its original and valuable properties destroyed or impaired. The powder generally known as "dry milk," although made from milk, is in reality no longer milk, nor can it be re-converted into milk, though owing to its nutritious value it is used extensively as an emergency food. In the Ekenberg process, however, the powdered milk, as it is termed, is actually dry milk easily soluble in water, and which, when re-constructed into its liquid form by the correct proportionate addition of water, becomes in every way similar to the original substance. Dr. Ekenberg discovered his process in 1899, but during the ensuing years many important improvements have been effected whereby the cost of producing the powder is now quite nominal, so that the product can compete commercially with either the fresh or condensed milk.

The feature of the Ekenberg process is that the heavy percentage of water present in the fresh separated liquid is rapidly evaporated at a low temperature under vacuum, the temperature at no stage of the operations being much higher than luke-warm. Upon arrival at the factory, the cans of milk are emptied into a small reservoir on the ground floor and then pumped to the receiving tanks located in the floors above. In Sweden, owing to regulations concerning milk, it is pasteurized at the dairies before being dispatched to market, so that at the milk factory this preliminary process is avoided. In other countries, however, where such regulations do not obtain, pasteurization is carried out before the elimination of the water is proceeded with. All empty cans are carefully and thoroughly sterilized with steam before being returned to the dairies. The milk is first filtered through a cotton medium whereby all foreign substances in suspension are arrested. It is then cooled by means of refrigerators to a point just above freezing and is kept at this temperature during the day's work.

The process of converting milk into powder consists in quickly drying the milk at the temperature of the blood or approximately 100 deg. F. For this operation a specially constructed apparatus evolved by the inventor and known as the "Exsiccator" (milk dryer) is utilized. In the majority of processes for extracting the water the milk is passed over or between rollers heated to a very high temperature, the powder being deposited upon the external surface of the rollers, from which it is subsequently removed by scraping devices. In the Ekenberg system the powder is deposited upon the inner face of a vacuum vessel. The exsiccator comprises a large, horizontal, cylindrical drum which is caused to revolve. The internal face of this drum is of nickel, which has been proved to be the most suitable metal for the purpose. The milk enters the exsiccator department through a floor standpipe, to which flexible pipes extend from each exsiccator, it being possible to provide as many supply pipes from this central source as there are machines for drying the milk. The supply is maintained by gravitation, the capacious tanks containing the raw milk being placed at suitable points above. The heating medium employed for evaporating the milk is exhaust steam, which is admitted to the interior of the drum when closed. In order to obtain high efficiency and rapid treatment the ends of the drum form bowls, dished outward, in which evaporation of the water to an extent of about four-fifths of the original amount takes place; here an evaporation effect of 160 to 180 kilogrammes per hour per square meter (295 to 330 pounds per square yard) is obtained, which is a higher result than has hitherto been possible, since a locomotive boiler, for instance, evaporates only 40 kilogrammes and a sugar vacuum from 60 and 80 to 100 kilogrammes per hour per square meter. This high evaporating efficiency is obtained by maintaining the milk in constant circulation. The solids of the liquid are deposited upon the nickel surface of the drum and are removed by means of German silver knives and deposited in a special receptacle close to the drum, this vessel being arranged for a periodic discharge of its contents either by hand or by a mechanical device. Upon the removal of the dry milk powder from the exsiccator it is submitted to a crystallizing process in a special chamber at a temperature ranging from 80 to 100 deg. F. It is left within this chamber for approximately one hour or until the sugar of milk has thoroughly crystallized. In this crystalline state the substance is of a very brittle nature and is now submitted to grinding and sifting operations in a mill in precisely the same manner as wheat flour, after which it is ready for packing in either tins, boxes, or barrels.

The exsiccators of the size in general use at the factories now in operation have a drying capacity of from 800 to 1,000 liters (211 to 264 gallons) of milk per hour, or about 15,000 liters (3,962 gallons) per day and night, allowing sufficient intervals for cleansing and emptying the machine. The consumption of steam is low, 100 liters (26 gallons) of milk requiring from 90 to 93 kilogrammes (198 to 205 pounds) of steam for complete drying. The cost of producing the powdered milk is also sufficiently low to render it commercially practicable, the cost of extracting the solids from one gallon of milk amounting to one cent, inclusive of wages, coal, steam-raising, depreciation of plant, and other establishment and maintenance expenses. This low price is furthermore reduced by the economy effected in the transportation of the dried product, owing to its greatly reduced bulk, which is one-tenth of the liquid milk. Powdered milk prepared on this system is therefore not dearer, but cheaper, than the fresh liquid article to the consumer, especially in view of the fact that the fresh milk can be obtained from those parts of the country where it is locally very cheap but where the difficulties and cost of transportation render it impossible to be dispatched to the markets of the great cities for profitable disposal. Moreover, the low cost of production renders it possible for machine-skimmed milk, which is in itself a perfect food and is perhaps purer than the whole milk (in skimming by means of the mechanical apparatus the greatest part of the natural impurities in the raw milk are removed and remain in the separator), to be made available for the masses in the large cities.

If required, the milk powder can be easily reconverted into its original liquid condition by the addition of about nine parts of water to one of the powder. The product of skimmed milk is easily soluble in cold water, in which it is widely divergent from the majority of dried milks, which only with difficulty dissolve in warm or hot water. In this process no foreign substances, to facilitate the conversion of the liquid milk into a stable substance, or preservative are added, and the fact that the skimmed milk and milk with a low percentage of fat are perfectly soluble in cold water is solely attributable to the vacuum treatment adopted, and which constitutes one of the most vital features of the Ekenberg process. It is thus possible for any one under varying conditions, such as soldiers and explorers, to obtain supplies of perfectly natural milk so long as they have access to fresh water. The only difference between the restored and the natural milk is a slightly boiled flavor such as is noticeable when the housewife in hot weather pasteurizes her ordinary milk by scalding it. This effect is attributable to the preliminary process of pasteurization and does not arise from the treatment of the milk in its conversion into powder, and it is only perceptible to an experienced palate. The purity of the restored milk is further testified by the slight sediment which is observable after it has been left standing for more than two hours, this sediment consisting of the albumen coagulated during the pasteurizing process. The experiences of later years have demonstrated the fact that such sediment cannot be avoided without the addition of chemicals, and pasteurized and dried milk must yield some such slight sediment. If such a result is not noticeable after two hours' standing, then chemicals must have been added to the milk at some time or another and in such a case the whole constitution of the milk is altered and no cheese can be made from the restored milk. In regard to these sediments it is to be remembered that the natural milk consists of a serum in which the casein and the fat globules are suspended; it is therefore truly remarkable that this milk powder can be dissolved in water and the milk reconstructed with its casein in its natural condition. However, this sediment is not of sufficient importance to prevent the utilization of the milk powder in the various commercial uses for which it is eminently adapted, such as bakery and confectionery operations. With the Ekenberg dried milk powder it was quite practicable to make cheese, which testifies to the fact that the inner construction of the milk is in no way altered by the drying process.

In comparison with the condensed milk which has now such an extensive vogue, the milk powder has a marked advantage. The ordinary condensed milk with sugar contains from 8 to 12 per cent of milk fat, depending on the quality of the brand, whereas the milk powder contains more than double the quantity, or about 25 per cent of milk fat. In the former, again, the percentage of dry milk substance aggregates some 40 per cent, the balance being sugar and water; the powdered milk contains 98.5 per cent of milk substance, the remaining 1.5 per cent being free moisture. One pound of condensed milk will yield 1.6 quarts of restored milk according to the usual directions for use, while the same quantity of milk powder will give 3.5 quarts. Whereas the condensed milk must be carefully stored in air-tight tins hermetically sealed under special precautions (since any puncture of the vessel will result in leakage and the ultimate fermentation of the contents), with the milk in powder no such apprehensions need be entertained, as a puncture of the tin can result in no serious harm, and it will keep in all climates and retain its sweet and pure qualities under all conditions. Furthermore, while the condensed milk is available only for the sweetening of fluid foods, the powdered variety is applicable in all dry food preparations appealing to domestic use, such as custard powder, cereal preparations, and so forth, as in its raw condition, owing to the milling and grinding operations to which it is subjected, it is of the same consistency and nature as the ordinary wheaten flour, while the absence of added sugar does not sweeten the preparations but gives the same results as if the housewife simply added the preparations desired with ordinary fresh milk.

In regard to the presence of bacteria in the Ekenberg milk powder the various analyses and severe tests to which samples have been subjected show the preparation to be free from such contaminations. Prof. W. Booth, of Syracuse, N. Y., who has made a thorough examination on this subject, found that even after a week's exposure to a temperature of 60 and 65 deg. F. no colonies of bacteria in suitable strata were mixed with the powder. This immunity is probably due to the bacteria-destroying influence of the serum-enzymes of the milk during the concentration in the vacuum, whereby the enzymes are kept in full activity.

SIDE LAUNCHING OF THE U. S. S. "PATUXENT."

We present on the front page illustrations of the side-launching at the Norfolk navy yard of an ocean-going tug, the "Patuxent." While the weight involved was small, the launching was in many respects unique, as it involved a side launching, together with a bodily drop of the ship of about five feet upon reaching the ends of the ground ways. Side launchings are a matter of frequent occurrence, particularly on the Great Lakes; but in practically every instance the ways are continued under water to insure the vessel being waterborne (i. e., supported entirely by water) before leaving them.

The Norfolk navy yard is not equipped with a building slip, nor with any modern means of handling materials over a ship on the stocks. Nor was the allotment of money for building the tug sufficient for cutting through the granite sea wall and laying the usual ways. Accordingly, as the cheapest way of building the vessel, she was erected close to the sea wall, the keel being parallel to the same. This involved laying the launching ways on the top of the granite wall. To insure the vessel being waterborne, the ways would require to extend a hundred feet beyond the sea wall. The expense of piling, and the obstruction of a narrow river, made this impossible, and dropping the vessel off the end of the ways was determined upon.

There were six ground ways, each extending 12 feet beyond the sea wall. Each ground way was cut just beneath the packing, and as the vessel passed the edge of the sea wall, the groundways lifted, and formed a fender which prevented the vessel from rolling backward, recoiling, and doing herself damage against the granite wall. A photograph was fortunately secured by Naval Constructor Battles, which is here reproduced, which shows clearly the tilted groundways and the angle reached by the tug in striking the water.

The "Patuxent" is an ocean-going twin-screw tug, 148 feet in length, 755 tons displacement, 1,160 horsepower, and estimated speed of 13 knots. A large bunker capacity, twin screws, and unusual speed make her an exceedingly valuable vessel, and she will undoubtedly prove a very serviceable addition to the new navy.

Correspondence.

Electrocution of Animals.

To the Editor of the SCIENTIFIC AMERICAN:

In reference to an article in the July 11 number of your journal, concerning the humane slaughtering of animals, I wish to call your attention to the fact that all the devices offered, at least all those mentioned in the article, for the solution of the problem seem to be of the mechanical order. Why is electrocution not made use of? In slaughtering upon a large scale, it appears to me that electrocution would afford more advantages than the use of any mechanical device, besides being humane enough for the requirements of the A. S. P. C. A. What could be more rapid than the quick application of a high-tension current?

Sherburn, Minn. WALTER ARP.

The Meaning of "Micro-photograph."

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to call your attention to the misuse of the word "micro-photograph" in legends on illustrations on pages 56 and 57 of your July 25 issue.

A micro-photograph is an ordinary photograph minimized to about the size of a pin-head for viewing under a compound microscope.

A photo-micrograph (which is what you show) is a photograph through a microscope of a magnified view of a microscopic object. Of course, I admit there is some "authority" in the misuse of the word as you use it; but in the interests of photo-micrography, I beg you to use the correct or better word. Even if there is sanction of your use of the word, it is illogical. What you want to express is not a *micro*-photograph, but a photograph of a micro-object. The photograph may be as large as the side of a barn.

EDWARD F. BIGELOW.

Stamford, Conn., July 27, 1908.

A Young Girl's Theory of Thunder Storms.

To the Editor of the SCIENTIFIC AMERICAN:

Can a twelve-year-old girl be scientific? Surely not. But I love to think and talk about such things; and who knows but that some day, kicking about in the dust, I may find a nugget as well as a man might. The following notions about the causes of rainfall I think to be new. They are interesting to me, also to some others, among them Prof. Loveland, of our State University, and I surmise they may some time be proved correct:

I, one day, during a thunder storm, said to my father: "What causes thunder?"

He replied: "It is the detonation resulting from a bolt of lightning leaping from cloud to cloud or from a cloud to the earth."

"Yes; we understand that is *what* it is. But what causes it?"

"Well, electricity is generated, in some way not clearly explained, by the condensation of vapor into rain."

"Did you, when a student, see any experiments in which condensation of moisture generated electricity?"

"No; I never did, but I have seen the exact opposite. I have seen water decomposed by electrolysis, i. e., an electric spark passed through water will resolve it into its con ponents, oxygen and hydrogen."

"Then, by the law of conservation of energy would not the reuniting of these component gases into water give back the electric spark that separated them?"

"Yes, I presume it would, though I have never seen any demonstrations to this effect."

"If such prove the case would it account for lightning and thunder?"

"No; not as we understand it. To account for lightning and thunder in this way would involve us in accounting for rainfall by chemical reaction—an entirely different theory from that which now obtains."

"What is the present theory of rainfall?"

"Why, simply this: The point of saturation of cold air is much lower than that of warm air. Hence, when saturated air becomes cooled it precipitates moisture in the form of rain."

"Did you ever see this done in a laboratory?"

"Yes. Often and in many ways. The sweating of a pitcher of ice water in a warm room attests it, also the mist falling from the exhaust steam of an engine on a cold day."

"Did you ever see water recomposed from its constituent gases?"

"Yes. You put them in an inverted bell jar and explode them and water moistens the table. We also see the same in the water dripping from the oxy-hydrogen blowpipe."

"Is the explosion attended by noise?"

"Oh, yes. It cracks like thunder and bursts the bell jar in a thousand pieces."

"Does it give off an electric spark?"

"It may. I never tested for it."

"Could rainfall be accounted for by a chemical reaction like that which bursts the bell jar, lightning being its liberated energy and thunder its detonation?"

"Probably not; though it is a novel and fascinating idea. The soft, thunderless rains of our winter season and those of the Pacific coast are doubtless the result of condensation only, as popularly supposed. But you lead me to think there is room for speculation as to the origin of the thunder shower. At any rate it is an interesting theme. Hunt it down as Kepler did his Laws of Planetary Motion and see if it fits the conditions."

And so I have been, and still am, "hunting it down," and the following is my catechism as far as formulated:

Q. What is the source of the free oxygen in the air presupposed by my theory?

A. All oxygen in the air is free oxygen. Air is a mixture, not a chemical compound.

Q. What keeps up the supply of oxygen if large quantities are consumed in the formation of rain?

A. The exhalation of plants in the process of growth. They inhale carbon dioxide, secrete the carbon, and exhale the oxygen.

Q. Then we would expect more oxygen and more rainfall in districts where vegetation abounds?

A. And such is the case; also more thunder and lightning.

Q. We would also expect fewer thunder showers in winter than during the summer months with their oxygen-exhaling verdure.

A. It rarely thunders in winter, or in arctic latitudes, or after frost has checked vegetable growth in the fall.

Q. Why does a thunder shower seem to follow a watercourse?

A. The vegetation, and hence the free oxygen, are more abundant along the valleys and watercourses. The rain cloud builds itself as it goes, and builds in the channel where the materials exist most abundantly.

Q. In what way does cultivation of the soil and the planting of trees increase rainfall?

A. Besides the physical results usually ascribed, it increases vegetation and the free oxygen which vegetation supplies.

Q. Is oxygen more abundant preceding a thunder shower?

A. Yes. It sometimes becomes so abundant as to compose a new element, ozone or compound. oxygen, which is found in the air just preceding and during a thunder shower.

Q. Is there free hydrogen in the air?

A. Yes, but in quantities disappointing to my theory.

Q. Can this dearth of hydrogen be accounted for?

A. Yes. Hydrogen has a density, or specific gravity only one-fourteenth that of air. Hence, free hydrogen in any quantity would be found in altitudes far above the air strata to which man can gain access.

Q. If so far above the earth, how would it get in contact with the oxygen?

A. Air currents would mingle them.

Q. Do winds, then, conduce to rainfall?

A. Most certainly, especially variable winds. This is obvious to all observers.

Q. But gases mingle together freely regardless of specific gravity; and so, if there were hydrogen in the air it would also be present at sea level?

A. It is present in small amounts in all natural atmosphere. Also the free diffusion of gases is only a partial fact. Carbon dioxide, for instance, will accumulate in wells and mines by reason of its greater specific gravity. It may also be poured from one vessel to another in the presence of the atmosphere and only slowly becomes diffused through the air. And yet its specific gravity is twelve times nearer that of atmospheric air than is that of hydrogen gas.

Q. How can we account for the large quantities of hydrogen in the air which my theory presupposes?

A. The only source I can suggest is the electrolysis of water. The force of the average thunder bolt, expressed commercially, is about $1,400, or equal to the oxidation of a thousand tons of coal at mine value—an enormous aggregate force. Water is one of the best natural conductors of electricity. Hence, lightning usually strikes in water or damp soil and its force, probably, is mainly spent in electrolyzing water and liberating hydrogen which would rise to the upper air immediately, while the oxygen would mingle with the air, which is of about the same specific gravity.

Q. My theory would lead us to expect an accelerated precipitation of rain following at each clap of thunder?

A. Yes. This is a universally noted fact. The freshening shower following a clap of thunder is the best and most direct proof of my theory. Some have tried to account for this by the jar imparted to the atmosphere, and in times of drought have bombarded the heavens in a vain and foolish effort to "jar the rain loose."

Q. If my theory be correct thunder is not the result of lightning. Why, then, do the two phenomena occur simultaneously?

A. Neither is the result of the other. Thunder and lightning are the twin results of a chemical reaction. The best evidence of this is the fact that, while occurring simultaneously, their evidences do not reach us simultaneously, for light and sound do not travel with equal velocity. A flash of lightning, however near us, reaches the eye before the thunder reaches the ear.

Q. Is it not more rational to say that the thunder is the snap of the electrical spark, so to speak?

A. Not at all. One sometimes sees the bolt of lightning and hears its snap or crackle, the detonation of the explosion that gave rise to both reaching the ear a second or two later.

Q. These explosions, when occurring near the earth, would be manifest in their damage to life and property?

A. And so they are. People and animals "struck by lightning" as we commonly call it, are often scorched and singed as if by an explosion of gas and are usually killed without being mangled or torn as we would expect if actually struck by a bolt of lightning. Also buildings are sometimes shattered and not fired; and at other times are fired but not shattered. A tree when struck by lightning is usually splintered, but I never saw evidences of burning in the channels cut by the lightning. On the other hand we often see trees inexplicably killed or the foliage scorched and killed without other evidences of lightning—two distinct classes of damage, one purely electrical, the other a shock and burning, the direct result of being within the zone of the oxy-hydrogen explosion.

Q. What of barometric pressure?

A. Since an unusual infusion of either hydrogen or oxygen, or both, would reduce the specific gravity of the air, my theory would harmonize perfectly with the low barometer preceding rain storms. Even though these gases should be present only in the higher altitudes, yet the barometer would record the lower pressure at all altitudes.

I have other questions yet to answer. I should like someone better equipped than I to discover for me the following, all of which my theory requires should be answered in the affirmative, and I ask them to write me what they discover or conclude, viz.:

1. Is there less free oxygen after than before a thunder shower?

2. Does free hydrogen become more abundant in the air as we ascend from the earth?

3. Is oxygen less abundant after a thunder shower on land and more abundant after a thunder shower at sea?

4. Does the explosion of oxygen and hydrogen gas in a bell jar give forth an electric spark?

5. If correct that electrolysis results when a bolt of lightning passes into the ocean, river, or damp earth, in what other way (than the one supposed by my theory) has the hydrogen gas thus liberated during the ages been taken up and the equilibrium of the air restored?

I do not dogmatize on this theory. I am too little gifted and too poorly equipped with knowledge of the commonest things. I expect some chemist or physicist to fulminate some little fact into my theory that will resolve it into gas thinner than those with which it deals. I am entirely willing he should do so. But if he should not? What then? I only ask that he give me notice when he shoots. EDITH E. CUMMINGS.

Beatrice, Neb., June 29, 1908.

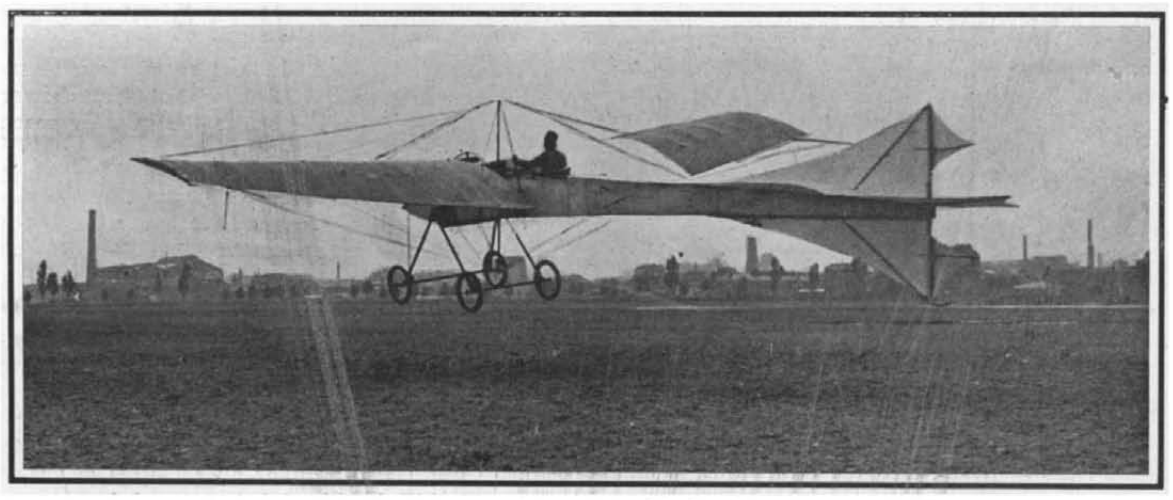
The petroleum pipe line between Baku and Batoum worked without a hitch during the year 1907. The only objectionable feature in connection with the enterprise now is, that in view of the decrease in the exports of illuminating oils from Batoum, there is not sufficient oil to keep the pipe line and its costly machinery continually at work, and the undertaking is, therefore, not as remunerative to the State Railway as was anticipated when the scheme for laying the line first came under the consideration of Russian government engineers. Besides this, merchants using the pipe line are subjected to a loss of 2 per cent of oil which the railway authorities deduct for leakages. Considerable loss of oil is also experienced through the tapping of the line by natives, who in many cases have been caught clandestinely drawing off oil. At Elizavetpol, for instance, quite recently a gigantic fraud was discovered. The town having only consumed one tank car of oil during 1907, an inquiry was instituted which elicited the facts that the pipe line had been tapped some miles to the east of the town, that a systematic robbery of petroleum had been taking place all the year, during which as many as from ten to twelve cart loads of oil were nightly drawn out of the pipe and conveyed to the town for disposal at retail during the day.

RECENT FOREIGN AEROPLANES.

The illustrations on this page show some of the latest aeroplanes which have made flights or which are soon to be experimented with in France.

THE FERBER AEROPLANE.

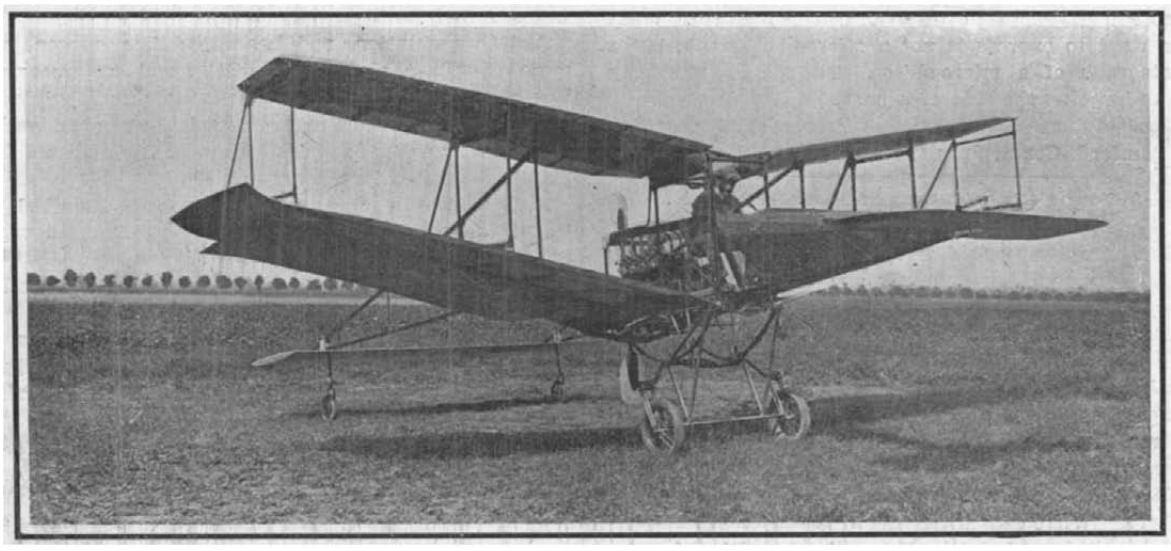
The first of these machines to be noted is that of Capt. Ferber, who has studied the problem of flight by a heavier-than-air machine the most assiduously of any French experimenter. This machine is of the double-surface type, the chief points about it being the slightly curved planes and the location of the motor in front and the aviator himself at the extreme rear edge of the planes. A horizontal projection of these planes shows that their front and rear edges form the arc of a circle. They are also suitably curved in a fore-and-aft direction. The surfaces are constructed of cloth and wood, but the other framework is of bamboo. The horizontal rudder is located well in front, and at a higher point than it is usually placed. The vertical rudder behind is triangular in shape, and is combined with a horizontal surface of the same form. Movable triangular tips at the ends of the planes are used for steering. The machine is mounted upon two wheels, placed one behind the other, and curved runners at the ends of the lower plane take the weight of the machine if it tips to one side when striking the ground. A 50-horse-power 8-cylinder Antoinette motor is placed at the forward edge of the aeroplane, and carries a 2.2-meter (7.22-foot) propeller of 1.1 meter (3.61 foot) pitch. The total weight of the machine is about 880 pounds. The spread of the wings is 10½ meters (34.44 feet), and the total supporting surface is 40 square meters (431 square feet). In its first trials, about a month ago, the aeroplane seemed to show fairly good stability. Several short flights of 10, 30, and 50 meters (33, 98, and 164 feet) were made; but in another trial on July 22, while making a flight of 120 meters (394 feet), Capt. Ferber directed his horizontal rudder downward, to diminish the height of the machine above the ground. This was readily accomplished, but in trying to turn upward again the control gave way, and the machine crashed to the ground and damaged the propeller and chassis. Before repairs could be made, the French aviators were forbidden the use of the parade ground at Issy-les-Moulineaux, and so no further trials have been made.



The Remodeled Gastambide-Mangin Monoplane Flying Above the Parade Ground of Issy-les-Moulineaux, Near Paris.

THE ZENS BROTHERS' AEROPLANE.

This aeroplane represents the greatest advance in the line of simplicity that has thus far been made. Its chief features are the reducing of the tail to a single horizontal plane, 5 meters (16.4 feet) long by 1 meter (3.28 feet) wide in a fore-and-aft direction, and the use of a single horizontal rudder, which is universally jointed and which can be swung around to an inclined position so as to be used as a vertical rudder as well. This rudder has 1.89 square meters (20.334 square feet) of supporting surface, its dimensions being 2.1 by 0.9 meter (6.9 by 2.95 feet). It is operated by a single steering wheel. The superposed surfaces of this aeroplane are not of the same length, nor are they set at the same dihedral angle. The upper surface has a spread of 8 meters (26¼ feet), is 1.2 meters wide (3.94 feet), and has a dihedral angle of 156 degrees; while the lower plane has 8.3 meters spread (27¼ feet), 2.3 meters width (7½ feet), and a sharper dihedral angle. The outer ends of this plane are flexible and curved upward. The surfaces are of varnished Japan paper, and they are shaped with three different curves. The total surface of this machine including the tail is 28 square meters (301 square feet). The tail is located considerably farther back of the planes than it was placed at first. The machine has a 50-horse-power Antoinette motor fitted with a Fiat carbureter. It has also a special radiator of thin copper tubes 2 millimeters (0.079 inch) thick, arranged on either side of the projecting bow that extends from in front of the aviator's seat forward to the horizontal rudder. The radiator is capable of carrying 24 liters (6.34 gallons). A 2-meter (6.56-foot) propeller is carried on the engine crankshaft. The overall dimensions of this machine are 8.4 meters (27.55 feet) long in a fore-and-aft direction, and 8.3 meters (27.22 feet) spread. The total weight is about 320 kilogrammes (705 pounds). The angle of attack of the planes is about 9 degrees.



The Zens Aeroplane, Which Has But a Single Rudder.

The tail consists of but a single plane, while the horizontal front rudder can be swung to a vertical position for side steering.

Capt. Ferber Flying on His New Aeroplane.

The motor and propeller are in front, while the aviator is seated behind. The machine has a small horizontal-and-vertical tail, but for side steering triangular rudders on each end are used.

RECENT FRENCH AEROPLANES.

As stated above, this machine is the simplest one of the double-surface type that has thus far been designed, and in all probability it will make some interesting flights before long.

THE GASTAMBIDE-MANGIN "ANTOINETTE II." MONOPLANE.

The monoplane constructed by Messrs. Gastambide and Mangin, which was illustrated in our issue of March 7 last, was one of the first monoplanes to make an actual flight. It did not fly very steadily, and soon came to grief, as it was not fitted with either horizontal or vertical rudders. After the accident, the machine was remodeled, and one of the present photographs shows it in flight. The tail with its horizontal and vertical rudders is shown very well in this illustration. The machine itself appears to be gliding on a fairly even keel, and with good stability. No accurate information as to the flights it has made of late has come to hand, but the photograph speaks for itself, and shows that in the remodeling of this machine it has been somewhat improved.

WILBUR WRIGHT'S AEROPLANE FLIGHTS IN FRANCE.

After the painful accident he met with on the Fourth of July, when a bursting water-pipe caused him to scald his hand, it is somewhat remarkable that Mr. Wilbur Wright was able, in a trifle over a month, to guide his new aeroplane in its first flights in France.

The first flight was made on August 8, above an old disused racetrack near Le Mans. This flight was about 1¼ miles in length, and was accomplished in 1 minute and 45 seconds. The machine left its starting rail readily, and circled around the track. There were many spectators present, and great enthusiasm was shown at this, the first public demonstration given by the Wright brothers abroad.

After two attempted flights earlier in the day, the first of which failed owing to an assistant not releasing the aeroplane in time and the second of which, 600 feet in length, was cut short by trouble with the motor, Mr. Wright, at 7:30 P. M., August 10, made an excellent flight of about 1¼ miles in 1 minute and 43 seconds, which was at a rate of about 43½ miles an hour. This flight was made in a dead calm and was officially timed. The following day, however, there was a wind of about 10 miles an hour, and about nightfall Mr. Wright made a flight of something over 2½ miles in 3 minutes and 44 seconds. He did not fly very high, but turned readily in and out among the trees with which the field is studded. The machine rose and fell, as well as turning sideways, and seemed to be under perfect control. On Wednesday morning, August 12, a still longer flight lasting 6 minutes 56 2-5 seconds was made. In this flight the machine undulated considerably, and at one time rose to a height estimated to be as great as 90 feet. The flight was officially timed by the Aero Club of the Department of the Sarthe. There was a wind of 10 miles an hour blowing at the time. Toward evening two other short flights were made in a gusty wind, the aviator keeping his machine close to the ground, but controlling it with the same skill as before. The height attained in the first flight was considered by experts as being very remarkable, and as showing the skill and daring of this foremost of all aviators.

The series of flights was terminated for a time on August 13, when, after a splendid flight lasting 8 minutes and 52 seconds in the morning, during which Mr. Wright made seven complete turns of the field at a height greater than the tops of the trees, he, at

the end of a second 2-minute flight, struck one wing in landing while attempting to make a sharp curve, and damaged the machine slightly. The first flight was made at 6:30 A. M., and there was a fresh breeze blowing at the time. This seemed to have no effect upon Mr. Wright's control of the machine, however, and he soared to a height of from 50 to 60 feet, and maintained this elevation with the greatest ease. As no material was at hand for repairing the aeroplane, several days will be required in which to do this.

The flights of Mr. Wilbur Wright have completely vindicated him in the eyes of the foreign aeronautic world, and all the aeronauts and men of science have watched his performances with the greatest enthusiasm. His brother, Orville Wright, expects to experiment with the aeroplane built for the United States government, during the present week, or the week immediately following, at Fort Myer, near Washington, D. C.

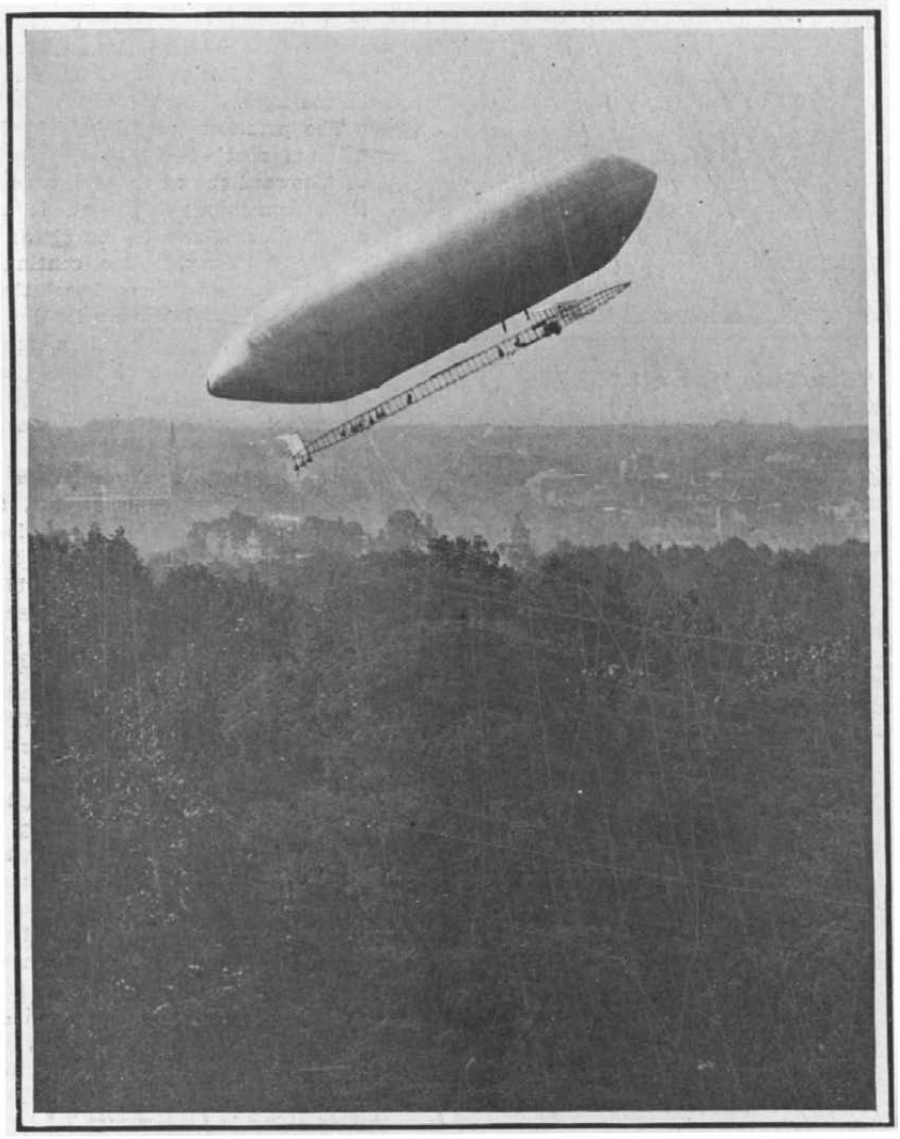
THE UNITED STATES AND BRITISH GOVERNMENT AIRSHIPS.

The dirigible balloons illustrated on this page are the two which have been built by Capt. Thomas A. Baldwin for our government, and by Col. Cody for the British military authorities. The Baldwin airship, as noted in our last issue, has been undergoing tests at between 18 and 21 miles an hour. The official figures were not obtainable at the time of our going to press. Capt. Baldwin expected to make the 2-hour endurance flight, in which he must average 14 miles an hour, the following day.

The plans of this new dirigible were published in SUPPLEMENT No. 1684. Unlike most of the foreign airships, Baldwin uses a long quadrangular framework below the gas bag and suspended from it by netting. The motor and the small aeroplanes, which act as a horizontal rudder, are placed at the forward end of this framework. The motor drives the propeller direct. The airship carries two men, one of whom operates the motor and the aeroplanes for up-and-down movement, while the other steers.

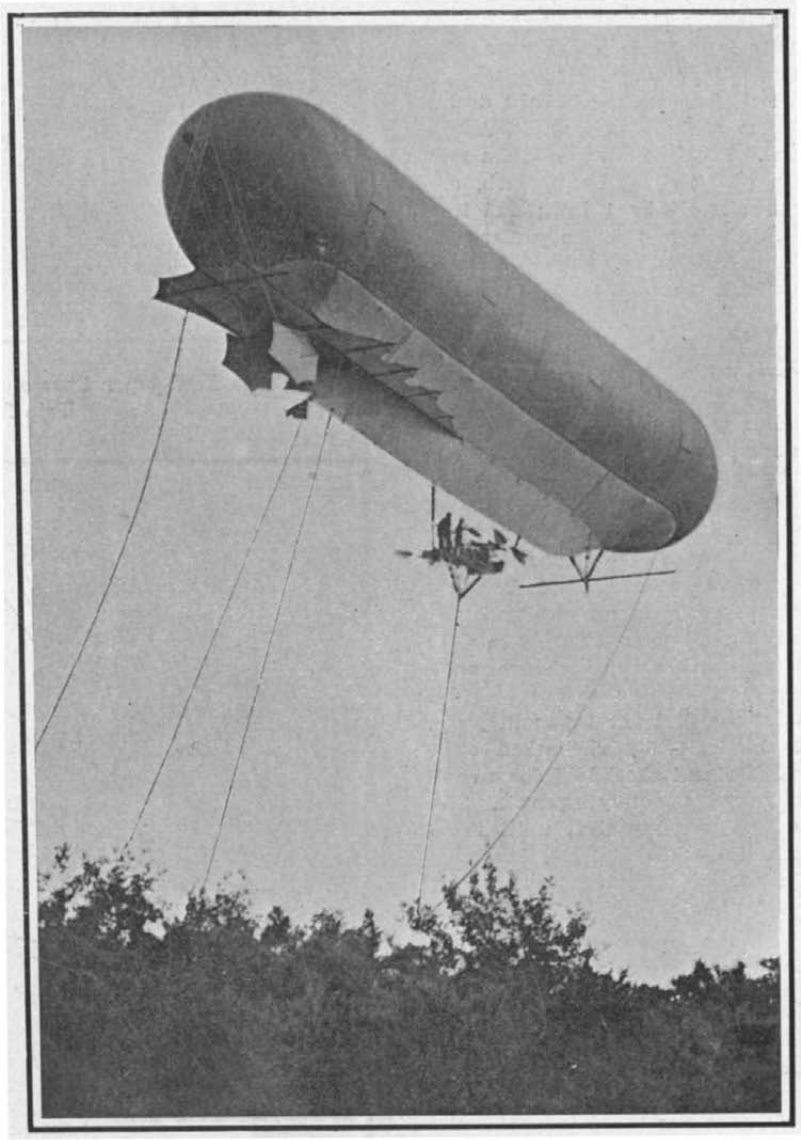
The British military dirigible, which we illustrate, is the "Nulli Secundus" of last year remodeled, fitted with a larger motor, and improved in various ways. In place of the old engine, a 50-horse-power Antoinette motor is now used. This is located in a short car placed below the center part of the airship, and it drives two propellers, one on either side of the car. The gas bag has been fitted with a flat surface on its under side, and the car is suspended below this. Hexagonal twin rudders are used at the rear in place of the single one employed before, and a horizontal rudder is placed in front. There is no netting on this airship, the framework of the horizontal plane and car being supported by heavy bands of fabric placed around the gas bag at intervals. The length of this airship is 120 feet, and the diameter 26 feet. Its 56,000 cubic feet of hydrogen gas give it a reserve lifting power of from 700 to 800 pounds. It is capable of carrying three men readily. The car is about 12 feet long, and the total height from the bottom of the car to the top of the balloon is about 45 feet.

On its first trial on July 24, the airship traveled 9 or 10 miles against a wind of 15 miles an hour. It rose to an elevation of about 1,000 feet, and there was no pitching noticeable. The chief trouble met with was the slipping of the driving belts which operate the propellers. After further trials have been made, it is expected that this airship will be put in use by the balloon corps of the British army.



Capt. Baldwin's New Dirigible, Which Was Constructed for the U. S. A. Signal Corps, Making an Ascent at Fort Myer, Near Washington.

This dirigible differs from foreign ones in having a long quadrangular body framework suspended from netting that covers the gas bag. The propeller is at the front end. Small superposed aeroplanes form a double horizontal rudder near the front end.



The Remodeled "Nulli Secundus"—the First British Military Dirigible Balloon.

Note the flat tail and rounded substructure of the gas bag, as well as the horizontal and vertical rudders front and rear, and the small car with its two propellers.

THE NEW AMERICAN AND BRITISH MILITARY DIRIGIBLE BALLOONS.

Washington as to its speed and enduring qualities. The first trial of the three allowed for the purpose of testing the speed of this new airship, occurred on August 12, but owing to trouble with the wiring of the 8-cylinder Curtiss motor, no favorable showing was made in this test. The previous day, however, the airship flew about 4½ miles against a strong cross wind, and developed a speed of some 15 miles an hour. The flight was from Fort Myer to Balston, Va., and back. The distance of 2¼ miles was covered in 8 minutes, or at a speed of 15.2 miles an hour. The return flight was made in the same time, but in returning the airship rose to an elevation of 1,000 feet. Upon reaching its destination the aeroplanes at the forward part of the body framework were directed downward, and the machine was made to descend slowly and gracefully to earth. Capt. Baldwin makes use of a drag rope in alighting, as by means of this the machine can be drawn down if necessary when it comes to rest.

The second and third official speed tests of this new dirigible were made on August 14 over a course extending from Fort Myer to West Cherrydale, Va. In these two tests the airship is said to have averaged

The Argentine Ant Makes Its Appearance in California.

One of the most dreaded insect pests is the Argentine ant, the scientific name of which is *Iridomyrmea Humilis Maye*. It is very small, being less than one-eighth of an inch in length, but is so pugnacious that it quickly exterminates or drives out the native ants of any territory of which it takes possession. It is a native of South America, and is almost unknown in the northern part of the continent, except in the Mississippi Valley, where it is found chiefly in the neighborhood of New Orleans. The efforts to exterminate it in the Mississippi Valley have proved fruitless. In Louisiana whole sugar-growing districts have been devastated by the pest, which not only works enormous injury itself, but protects plant scale and cotton-plant lice, rendering them highly destructive to the cotton fields and to fruit and ornamental trees. No wonder, therefore, that its arrival in East Oakland, Alameda County, Cal., where it has occupied a square mile of territory, is viewed with alarm by entomologists. Many residents in the infected region have discovered it, and sent notice of its arrival to the entomological department of the University of California at Berkeley, Alameda. County. At a conference held by the members of the entomological department on July 14, the advent of this formidable ant was the chief subject of discussion, and Prof. C. W. Woodworth, who has been investigating the ant, has sent the following communication to J. M. Gillett, Governor of the State of California:

"I have the unpleasant information to report that the Argentine ant has gained a foothold in East Oakland, and now occupies about one square mile of territory. The insect is known elsewhere in the United States only in the region about New Orleans; and the secretary of the Louisiana Crop Pest Commission, in the last report of the Governor of that State, writes that the insect has proven itself to be one of the most injurious that has been introduced into the United States from foreign countries. A most serious aspect of the problem is found in the destruction of orange and fig crops in the southern parishes by the ant, and the danger to sugar cane by its continued increase. It seems to me that the introduction of the insect is a far greater menace than the introduction of the white fly, discovered a year ago at Maryville. I have already reported the matter to State Horticultural Commissioner J. W. Jeffrey, but I consider it important enough to report direct to you."

Japan's advance in machine building is indicated by the fact that its exports during the last year were five times greater than the average for the last five years. A large proportion of the exports consists of cotton gins, textile machinery, and printing presses, for China.

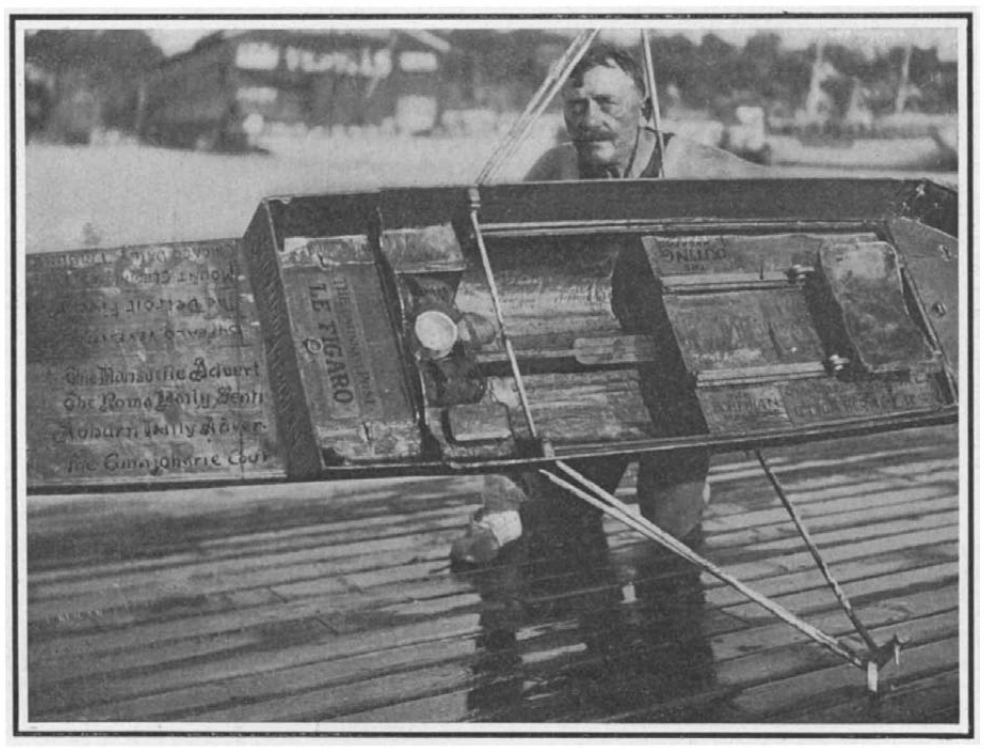
A BOAT MADE OF NEWSPAPERS.

On July 13 of the present year there might have been observed, sculling leisurely from the mouth of the Raritan River into New York Lower Bay, a bronzed and weather-beaten boatman, whose racing shell, because of the fact that it was covered from stem to stern with the printed headings of newspapers representing practically every corner of the globe, made an immediate bid for notice and closer inspection. The boatman was Capt. George W. Johnson, fifty-eight years of age, but looking forty; and his polyglot boat, built by himself of some three thousand newspapers, had served to carry him during the preceding two months on a 1,200-mile trip from St. Augustine, Fla., to New York harbor, practically the whole of the trip being made on salt water, and not a little of it on the open sea. Of course, the greater part of the route followed lay in inland waters, although in crossing some of the sounds the little craft was at times many miles from the nearest land. Thus, in crossing St. Andrew's Sound, an open stretch of six miles had to be crossed, and five miles across St. Symon's Sound. After entering Chesapeake Bay, Capt. Johnson followed the west bank to Annapolis, whence he rowed across the 12-mile stretch of water to the east shore. Another reach of 12 miles was made in crossing the mouth of the Potomac River. Naturally, he hugged the land pretty closely, being usually from 50 feet to a quarter of a mile from shore.

The little craft was built during the month of April at St. Augustine. The frame consists of a keelson of wood, ½ by ¾ inch, and gunwales, ⅞ by 1 inch; and it is divided into thirteen water-tight compartments by twelve bulkheads ¼ inch, ½ inch, and 1 inch in thickness, according to position. The method of laying on the paper shell was as follows: Molding strips ¼ by 1 inch were laid longitudinally from bulkhead to bulkhead, being fastened to false battens nailed around the edges of the bulkheads. Upon this form, of which the battens and molding strips alone were temporary, the paper shell was built up. The first set of sheets was laid with a 3-inch lap, and the successive layers were put on with a 1-inch, 2-inch, or 3-inch lap, as the case might be. After the first sheet was in place, it was carefully shellacked over, and the next sheet laid down carefully and smoothly upon it. The process was repeated, until there were thirty thicknesses, involving the use of three thousand pages, the final thickness of the shell being about ¼ of an inch. A special shellac of three pounds to the gallon, much thicker than the usual painter's shellac, was used. The deck was built up of eighteen thicknesses of paper. In placing the last layer on both the hull and the deck, care was taken to expose the headings of the papers, and as these represent all the countries of Europe, papers from places as widely separated as Egypt and Japan, to say nothing of papers from every State in the Union, from Nome, Alaska, to San Diego, Cal., the little craft has a decidedly cosmopolitan flavor. The boat is 20 feet long, 20 inches beam, 6 inches deep, has 3 inches draft, and 3 inches freeboard. When it was first placed in water it weighed 91 pounds; at present its weight is 150 pounds.

The adventurous captain of this small craft, who was formerly a printer on Frank Leslie's, is one of the oldest of the well-known scullers on the Harlem River, and was one of the organizers of the Nonpareil Boat Club. Careful attention to diet and a wholesome outdoor life, with abundance of exercise, show their effect in his fine physique.

The Newspaper Boat on Its Arrival at New York After a 1,200-Mile Trip from St. Augustine, Florida.



The Shell of the Boat is Built Up of Newspapers from All Parts of the World.

A BOAT MADE OF NEWSPAPERS.

Experiments have recently been made in Berlin to ascertain the height at which a balloon may be considered immune from hostile rifle shots. Captive balloons were sent up, and they were shot at from angles of from 15 deg. to 45 deg. Balloons traveling at a height of from 600 to 2,000 yards could be hit only once out of six shots, while they were absolutely safe at a height of 3,000 yards. Even when struck, the damage to the gas bag was so small that the balloon was able to continue its journey for hours before the escaping gas made a landing necessary.

Electrical Resistance of the Human Body.

The average resistance of the human body from the feet to the hands, when the soles of the shoes are saturated with water and the hands are wet, is about 5,000 ohms, and may be represented approximately by the resistance of a copper wire 1/10 millimeter (1/254 inch) in diameter and 2,350 meters (7,710 feet) in length.

The conditions mentioned above are the most unfavorable that occur in practice. In ordinary conditions the comparative dryness of the shoes and hands increases the resistance to between 10,000 and 20,000 ohms. Assuming the resistance to be 20,000 ohms, a current of 1/200 ampere will traverse the body if the hand touches a 100-volt circuit which is completed through the earth or through a return wire which is intentionally or accidentally grounded. If it is a direct-current circuit no harm, except a disagreeable sensation, will ordinarily result.

But contact with an alternating circuit of 100 volts and 50 cycles per second, such as is often employed in practice, will produce (although the current which traverses the body is still only 1/200 ampere) a condition of paralysis or spasm which will make it very difficult to let go the wire. Contact with an alternating circuit of 500 volts or over is extremely dangerous, especially if the contact is such that the derived current passes through a vital organ.

Polishing a Varnished Surface.

In order to obtain a good surface for polishing, each coat of varnish must be sandpapered, rubbed or mossed down, as a polish can be obtained only on a surface that is perfectly level. Therefore, the last coat of varnish, when thoroughly dry and hard, must be rubbed with No. 00 steel wool or FF pumice stone and water or oil, following with rotten stone and water or oil, and when perfectly done cleaned off thoroughly to avoid scratches. For producing a very fine polish, says a well-known authority, mix with one pint of shellac that has been cut in grain alcohol one-half pint of raw linseed oil. Shake well every time when applying it to a woolen cloth, rub briskly until the polish is hard and lustrous.—Carpentry and Building.

According to Power, a flexible glue for attaching leather to metals may be made by adding 1 part of Venetian turpentine to 4 parts of glue. The mass is heated in a glue pot as usual until it becomes sticky and ceases to give off bubbles. It works best when fresh.

WHY DO ROOTS GROW DOWN AND SHOOTS GROW UP?

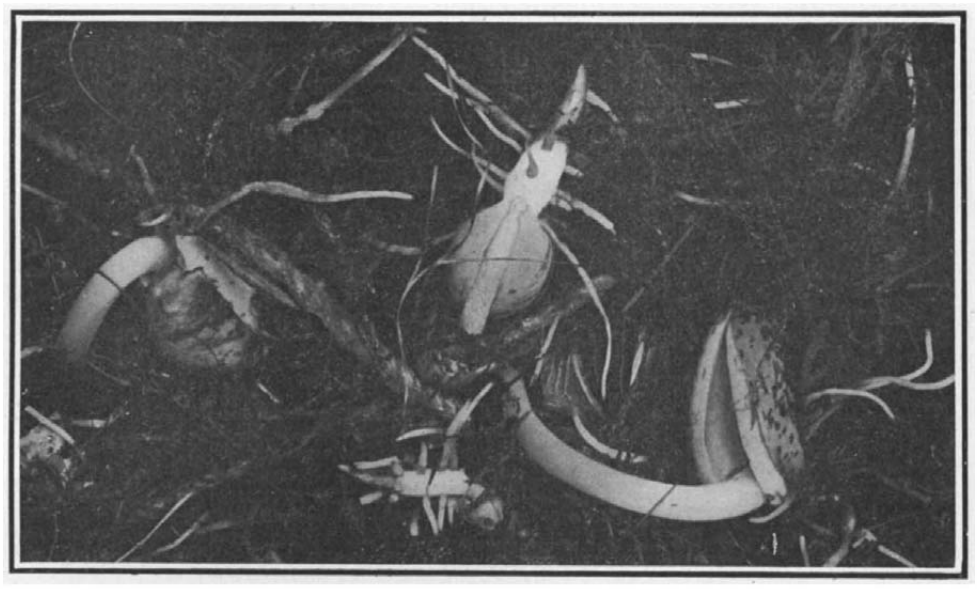
BY S. LEONARD BASTIN.

Given a suitable environment, the living seed will always be ready to germinate; by a wise ordering the conditions necessary are, with the exception of light, identical with those essential for the subsequent development of the plant. A sufficiently high temperature, a small supply of moisture, the free access of air, and the tiny embryo which may have been slumbering for years starts into life. One change follows rapidly upon another in this awakening of the plant. Externally in most cases there is first apparent a decided increase in the size of the seed. If one could look inside at this stage the beginnings of the plantlet would be apparent, and it is easy to distinguish the root and shoot of the specimen which will soon make its entry into the world. Very little time must be lost now, for the baby plant is entirely dependent upon the food supply packed away in the seed, and this is strictly limited. Before all the matter is gone, the plant must have established its own independence. But it is not long before the elongation of the root and the shoot brings the two chief parts of the plant out into the world, in which they will henceforth have to make their way. However the seed may be disposed, the radicle invariably dives downward, while the plumule extends up toward the sky. A common enough occurrence certainly, and yet one which in its attempted explanation has provided the puzzle of the ages.

The persistency with which the original root of the seedling will turn toward the earth, even though it is constantly hindered, is remarkable evidence to the strength of the tendency. The continual turning of a growing seed each time the radicle has taken up its downward course, results in a most strange distortion of the root. After witnessing the almost pitiful struggle, it has been commonly suggested that the root wants to bury itself in the darkness of the soil. This can be proved, however, to be quite a mistaken impression. Seeds planted in a shallow box filled with soil, and in which the bottom has been bored with numerous holes, send their roots downward out into the light just as if they were in the ground. By this same experiment it is obvious, too, that the radicle does not go where it can secure moisture. It is possible to grow seedlings upside down by the simple process of inverting a receptacle in which they may be placed. A most interesting demonstration, and one which is quite easy to carry out, is arranged with a cigar box filled with damp moss and planted with a few French bean seeds. By means of string, the moss is held in position, so that it will not fall out when the box is placed upside down. The whole thing is then suspended in a fairly light position, and by means of a mirror placed underneath, the surface of the moss is kept well illuminated. It is of course necessary to keep everything quite moist, and if this is done the seeds will quite soon germinate. Even under such conditions the growth of the newly-born plants will be on the usual lines as far as it is possible. The roots will endeavor to grow down toward the light, and most of the shoots will try, quite vainly of course, to make their way up through the bottom of the box. Some of these latter may contrive to grow out horizontally for a space, and so get a chance to turn upward when the edge of the box is reached. It is noteworthy that the upper part of the seedling is more able to adapt itself to special circumstances than is the radicle.

It is thus apparent that in the behavior of the young plant at its birth, there are more powerful factors at work than light and darkness, great as are the influences of these upon vegetation in after life. In order to get a more clear idea of the facts of the case; a certain Mr. Knight, a member of the Horticultural Society, arranged an experiment which has ever since been connected with his name. On the rim of a vertical wheel, which was continually kept in slow motion, some bean seeds were sown. It was devised so that the circumference of the wheel was constantly in contact with water, and thus every inducement was given to the seeds to develop. In this case, the radicle took up a very pronounced position, growing straight out away from the axis of the wheel. Evidently, owing to

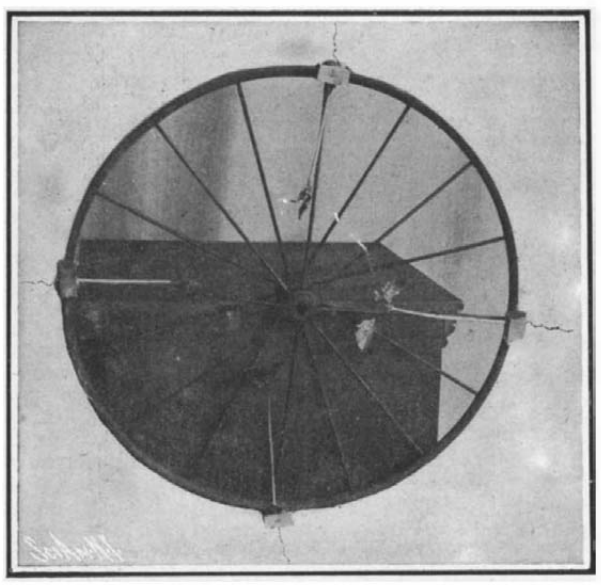
the neutralization of the force of gravitation, due to the movements of the wheel, the growth of the plants was entirely controlled by the centrifugal motion. In another case the wheel was permitted to revolve horizontally, and the plants behaved in a most curious style. Here the roots took up an intermediate course; evidently the power of gravitation was strongly at work, and only partly neutralized by the revolution of the wheel. It is then fairly clear that the roots act largely in response to gravitation, but this fact does not in itself appear to bring us much nearer to the solution of the problem. If the radicle is influenced by the great force, how comes it that the plumule is able to develop in complete opposition? Moreover, all plants do not send their initial root toward the earth, as is to be seen in the case of mistletoe and other parasitic plants. These species direct their roots to the center of the tree on which they are growing, meanwhile the stem rises perpendicularly.



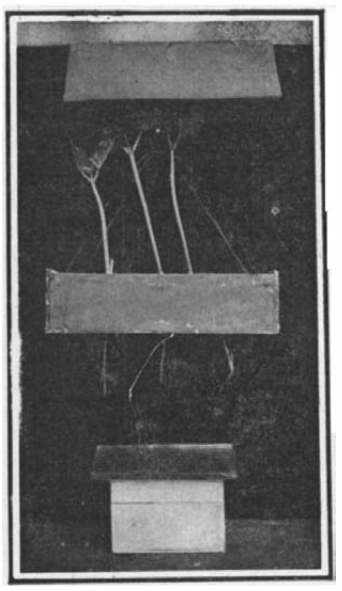
Seeds that have been grown in a box face downward. Note how secondary roots come to rescue.

The unalterable downward trend of the first root is all the more remarkable, when we consider that the subsequent ramifications grow out in any directions which seem to be desirable. Many years ago Col. Greenwood started some experiments by fixing horse chestnut seeds in inverted pots. The first root to appear developed downward into the light, but naturally soon shriveled up and died. Not so the secondary roots, which had spread into the soil of the pot. The upper parts of the plants, which had presumably first grown to one side and then shot upward, continued to flourish exceedingly. It is recorded that for no less than twenty years Col. Greenwood kept one of these chestnuts alive, all the time in an upside down condition as far as the roots were concerned. When the plant became too large for its original receptacle, its roots were incased in a chimney pot, several of these latter being called into requisition as the experiment continued. Finally the root was turned over a wall and conducted to a mound of earth on the other side—at last being allowed to take a natural course. This the long-suffering tree readily did, and remained for some time a great curiosity with its long arching root.

A less protracted experiment, and one which will answer every purpose to prove the adaptability of other roots, may be conducted with a hyacinth bulb. Get a piece of sponge, and after making an incision into the under side, place the bulb into the cavity, tying it well into position. Now suspend the sponge upside down, and keep it well supplied with moisture. The bulb will be found to root well up into the tissue of the sponge, and the leaves and flower will curl up to the light. A very pretty experiment on the same lines may be conducted by getting a large sponge which has a number of holes in its surface. Fill all these up, both the upper and the lower side ones, with scilla bulbs, and hang the sponge in a light situation. Keep well supplied with water, and in a short while the bulbs will send out their leaves and ultimately blossom, transforming the sponge into an object of great beauty. Of course, it must be borne in mind that the bulb is not in any way equivalent to the seed. Strictly speaking, a bulb is to be regarded as a metamorphosed bud, and any roots which may be sent out are comparable with those developed in the later growth of a plant. It will be seen that not one of the experiments mentioned above can be brought forward as offering a complete solution of the mystery. What is it that causes the radicle to go downward? It is clear that the habit is a most valuable one from the little plant's point of view, in that it enables the specimen to get a good hold in the soil. The upward growth of the plumule is actually almost as great a puzzle as is the downward tendency of the root. True there seems to be more adaptability about the shoot, as is noticeable in the case of seeds which are grown upside down. The classical experiment by Col. Greenwood, to which reference has already been made, proved that the plumule will twist round so as to get into its proper position.



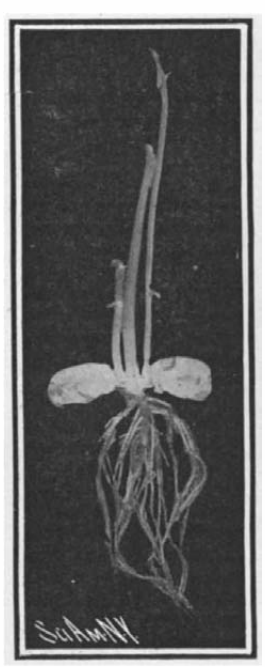
The roots grow centrifugally on a rotating wheel.



The roots are growing toward the light reflected by the mirror.

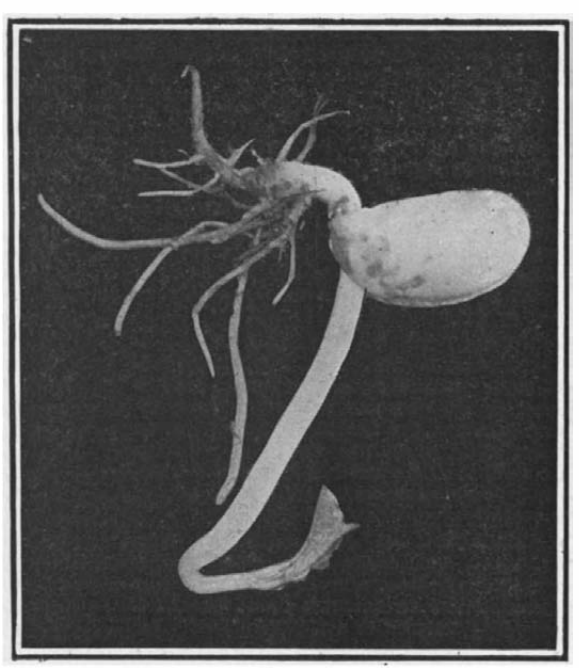
For a satisfactory explanation of the mysteries surrounding the birth of the plant, we must look in other directions than those with which the experiments have been connected. Of recent years there has been a good deal of attention drawn to what is known as the theory of tropism. Without going deeply into a most fascinating subject, it may be explained that the thesis implies the conception that living matter often acts in a certain way for no other reason than that it has an inherent tendency to do so. It is suggested that certain organs in animals perform their duties through tropic action rather than that they are directly stimulated by living impulse. The same principle undoubtedly applies to plants, an excellent instance of which may be observed in the case of the common Virginia creeper. It has long been known that the tendrils of this climbing plant are always striving to get into dark places, such as crevices in a wall, where they will naturally more readily get a hold, and so support the shoots from which they arise. Now that the tendrils should be endowed with this habit of negative heliotropism, as it is called, is all the more remarkable, when we remember the origin of these organs. There can be small doubt that all appendages of this nature are really metamorphosed leaf buds, and these latter are of course normally attracted to the light. The problem of the germinating seed comes into the same field of argument. In some way the initial root of the seedling is equipped with an inherent tendency to positive geotropism; that is, it is always drawn down toward the earth. Although not to the same definite degree, the plumule is endowed with a reverse inclination—negative geotropism, or the custom of growing away from the earth. Beyond this it is not possible to go at the present time, as we do not know anything regarding the underlying influences which control the tendencies so widely evidenced in living things.

Silvering of Horn, Ivory, Bone, Leather. etc.—In practical operations, the silvering of such materials, alone or in connection with other substances, is necessary. For this purpose, the objects are first heated to 140 deg. to 176 deg. F., and painted with a hot solution of gallic acid in water, then with a solution of 1 part of nitrate of silver dissolved in water and the alternate paintings repeated until the silvery appearance is produced.



When the plumule was broken off the resourceful seedling sent up two in its place.

1. Contortions caused by continually turning a seed. 2. When the radicle is checked the little roots grow downward from it. 3. Normal development showing downward trend of radicle and upward trend of plumule.



If it cannot grow downward the radicle stops growing; but the little roots feed the plant and the shoot curls upward.

WHY DO ROOTS GROW DOWN AND SHOOTS GROW UP?

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

WRINKLE-ERADICATOR.—FLORA A. PARIS, New York, N. Y. The purpose of this invention is to provide a device for eradicating wrinkles from the human face, and to so construct the device that it will be exceedingly simple and light, and so that it can be expeditiously and conveniently applied and removed, and worn without material discomfort.

Of Interest to Farmers.

GATE.—J. W. MATTHEWS, Brady, Tex. An object of the inventor is to provide a farm-gate which can be opened and shut from points remote from the gate itself, which is positive in operation, and which requires little force to close or open it. It can be operated at a point remote by an occupant of a vehicle, and when opened, remains in that position until a further manipulation of the operating parts closes it.

Of General Interest.

MATCH-BOX.—C. W. OERTEL, New York, N. Y. The object of the invention is to provide a match box made of a single piece of paper, which is simple and compact in construction, more especially designed for pocket use, and arranged to permit ready access to the loose matches for convenient removal whenever it is desired to use the same.

LEAD-PENCIL.—W. B. MCKIM, Elizabeth, N. J. One purpose of the inventor is to provide a pencil with a removable magazine clip for the sticks of lead, which clip can be manufactured and sold independently of the holder, and can be readily placed in position in a holder, secured therein, and be conveniently and expeditiously removed therefrom when empty for the introduction of a loaded clip.

FOLDING FIELD-GLASSES.—J. B. KISSNER, Baltimore, Md. Each of the sides of the separate barrels or tubes of the field glass folds separately, but the swinging frames and supports fold together. A spiral spring is arranged around the pivot pin of the folding frame, one end of the spring engaging a flange, and the other the frame, the spring acting normally to swing the connected frames outwardly from the back. Recesses receive the swinging frames and when folded the glass occupies but little space.

HORSE-COLLAR.—T. G. HADAWAY, Athens, Ga. This is a double collar, that is, one having two pads, an inner and an outer. By the arrangement of the connection between the roll and the two pads, they are all firmly secured and a space and roll shoulder are provided for the hames, which renders it practically impossible for the hames to slip off the roll. A leather neck pad is stitched to one of the inner pads at one side, and a strap and buckle connect the ends of the pads.

COOP AND CRATE.—G. HEIM, Newport News, Va. By this invention a coop or crate is provided which may be made of one or more units and in which units may be added to increase the capacity of the coop to any desired practicable extent, and in practice it is preferred to make the units alike so that they can be readily added and removed and so repairs can be readily effected whenever desired.

METHOD FOR COKING HYDROUS BITUMINOUS COMBUSTIBLES. — P. HOERING, Berlin, Germany. The invention does not permit the escape of steam from the substances operated upon. The steam is generated in great quantities during the drying of aqueous bituminous combustibles, which precedes the coking, and the steam is utilized by causing it to act upon the material to be coked, for which coking a coke-oven of any kind may be used.

STERILIZING AND PRESERVING POSTS AND POLES.—H. P. FOLSOM and H. JONES, Circleville, Ohio. In this improvement the object is to so treat the post or pole as to thoroughly disinfect the same to stop decay and kill any germs or parasites that may be at work, and at the same time, to prevent further access of germs, air, insects, or other cause of decay, infection, or deterioration.

LOOSE-LEAF BINDER.—A. CHRONIK, New York, N. Y. This leaf binder is simple and durable in construction and arranged to permit convenient opening of the binding flanges for the insertion or removal of the leaves and to allow closing of the binding flanges for securely binding the leaves in place, the binder being adapted to be locked against the removal of the leaves by unauthorized persons.

MANUFACTURE OF COVERED WIRE.—C. V. ACKERMAN, Passaic, N. J. The wire is covered by an insulating plastic substance such as cement or the like, and this substance is inclosed in a wrapper formed of sheets, such as a sheet of tin or the like, the wrapper serving as a mold for the substance during the subsequent vulcanizing or other hardening process of the substance.

LETTER-CLIP.—C. A. LOCKE, Salt Lake City, Utah. This device is especially adapted for use in post-offices, railroad offices, and other large establishments handling a quantity of letters, and is designed to avoid the necessity for tying the letters up into separate packages as is now commonly done. The invention relates more particularly to a clip adapted for use in holding a plurality of letters together.

THEATRICAL PROPERTY.—M. FORTUNY, 29 Boulevard Berthier, Paris, France. The object of the invention is to provide a concave wall or shell in a simple and inexpensive manner, and the invention consists in a pliable material, such as canvas, cloth, or the like secured to a rigid structure so as to form with the structure an air tight space and means for exhausting the air from said space, whereby the pliable material will be drawn towards the walls of the structure to form a concave surface or background.

TENSION-GUIDE AND THREAD-CLEANER.—W. J. ENGLISH, Cohoes, N. Y. The purpose here is to provide a continuous tension guide and thread cleaner, which will most effectually split lumps, motes, and other protuberances from the thread in its passage from a bobbin to a reel, free acting and opposing permanent magnetic strippers being provided for the purpose, between which the thread passes, which strippers are loosely mounted in a suitable frame and applicable to any form of winder or reel.

DISPENSING AND MEASURING APPARATUS.—C. DACOSTA and P. DACOSTA, Cienfuegos, Cuba. The invention relates to dispensing and measuring apparatus, and more particularly to that class for dispensing and measuring granular material such as sugar, flour, and the like. One object is to provide an apparatus having manually operable means for dispensing a predetermined quantity of material from a bulk of the material contained in the receptacle of the apparatus.

GEOGRAPHICAL GLOBE.—H. HARGER, Lost River, Idaho. The globe is particularly intended for use in schools. It is hollow and sectional and provided with means for securing the sections detachably together and to the axis upon which the globe revolves in a suitable frame. A curved and graduated ruler is employed, adapted to swing around the globe, and for use in indicating and drawing meridians and parallels on the surface.

Hardware.

RATCHET-WRENCH.—A. J. HIGBEE, Callaway, Neb. The invention is an improvement in ratchet wrenches in which a handle is provided with an enlarged head having a circular cavity which receives a rotating block provided with a recess adapted to receive a nut and also a movable jaw forming one side of such recess.

HARNESS.—E. B. GUERIN, East Orange, N. J. The invention has reference to an improvement in harness and has for its purpose the provision of means for attachment between the collar and neck yoke, which will provide for a closer and stronger hitch than is ordinarily obtained and which will render the harness less expensive.

CHANNELING-TOOL.—J. C. MERCER, Barre, Vt. A tool constructed in accordance with this invention considerably saves in time and labor over the usual method of working granite, and can be used to great advantage in hollowing vases, cutting windows in vaults, cutting steps and such other similar work; also, after the stone has been cut, no further dressing is generally needed.

Heating and Lighting.

BUILDING-LIGHT. — P. SCHWICKART, New York, N. Y. The invention refers to walls, skylights, floors, and other parts of buildings, and its purpose is to provide a light which is simple and durable, exceedingly strong in construction, cheap to manufacture, easily and conveniently set up, and arranged to insure a proper and uniform distribution of the rays of light.

HEATING AND VENTILATING DEVICE.—T. JAAP, Belt, Mont. The device is especially adapted for school rooms, or places where a large number of people congregate. Warm air rises to the ceiling, while cold settles to the floor, and carbonic acid gas is heavier than air and settles toward the lowest part of the room. This principle is made use of to obtain a circulation, the heated air passing from the furnace to the room in the ordinary manner, and the foul air passing from the rooms to the furnace.

WALL WATER-HEATER.—J. H. MACKLEY, Denver, Col. The heat from a burner circulates up through the inner heating space, thence across a cross space and down along the inner side of a depending baffle plate, and then up along the outer side of said plate, and thence along the bottom and sides of the pan and out at the outlets, so that nearly all the heat units will be extracted before the products from the burner are discharged at the outlets.

Household Utilities.

FRUIT-JAR COVER.—S. J. VASALY, Little Falls, Minn. The invention comprises a securer for a jar cover constructed of metal in annular form and adapted for detachable connection with the body of the jar, its upper portion being bent inward and downward, and the edge inturned and inclined downward at an angle to the horizontal, whereby it is adapted to form a spring bearing for a cover proper.

HYDROCARBON-BURNER.—W. H. CALLIHAN, Beaumont, Tex. The object here is to provide a burner for stoves in which the hydrocarbon is fed over a wire screen through which the air passes, and in this way form a proper mixture for combustion. An object is to provide a trough in which the hydrocarbon is contained and from which it is fed by absorbent material by capillary action.

Machines and Mechanical Devices.

LEACH-CLEARING DEVICE. — W. FERGUSON, Kizer, Tenn. The object of the invention is to produce a device which will operate automatically to feed itself or advance downwardly into the leacher as the spent tanbark is ejected by it. It concerns itself especially with improvements in the means for driving the feeding mechanism, and for raising and lowering the mechanism to its operating position.

CHANGEABLE-SPEED GEARING. — W. SCOTT, Sheridan, Wyo. The object of the inventor is to provide a changeable speed gearing, more especially designed for use on automobiles and other motor vehicles and machines, and arranged to permit the operator to conveniently and quickly change the speed of the driven shaft or axle, or reverse the same whenever desired.

AUTOMATIC PENCIL-SHARPENER.—L. B. CHADWICK, Boston, Mass. The purpose here is to provide novel details of construction for a sharpener, preferably operated by electricity, and which will produce a fine tapered point on the pencil, the act of placing a pencil in the machine starting the same and continuing the operation until the pencil is removed.

SIPHON.—W. P. LOCKE, Canton, Ohio. The present invention is provided with means for exhausting the air, a piston and cylinder being used instead of a collapsible bulb. It relates particularly to starting devices for siphons which act by exhausting the air from the siphon, and is intended as an improvement on the siphon shown in the patent formerly granted to Mr. Locke.

Musical Devices.

PIANO-PLAYER ATTACHMENT. — C. E. PRYOR, Binghamton, N. Y. Mr. Pryor's invention relates to musical instruments and more particularly to piano players having pneumatic action, his more particular purpose being to provide means under easy control of the operator for opening and closing the doors by the depression of a pedal or other simple movement.

ACTION FOR UPRIGHT PIANOFORTES.—J. DELERUE, 10 Campo da Regeneração, Oporto, Portugal. The action is provided in a well-known manner with a check arranged under the hammer-butt. The invention consists essentially in arranging at the upper part of the jack a lateral arm and in mounting the check on a U-shaped spring secured near the axis of the whip and passing through an opening of the jack.

PNEUMATIC ACTION FOR SELF-PLAYERS.—F. B. LONG and E. A. TAPPE, Los Angeles, Cal. This invention relates to cabinet players, self-playing pianos and like self-players, and its object is to provide a pneumatic action, arranged to insure long life, especially as to the pneumatics, and to produce a quick and accurate response of the keys or strikers, according to the pneumatic to be produced.

Railways and Their Accessories.

SWITCH.—B. G. WATKINS, Nehawka, Neb. The invention pertains to switches and is particularly useful in connection with overhead or suspended track rails. An object is to provide a switch for overhead, single track, tram or railway systems such as are used in storage-warehouses, packing houses, and the like, by means of which a car can be easily and smoothly guided from one track to another.

FIRE-EXTINGUISHER.—N. P. MATLOCK, Chickasha, Okla. The aim of this invention is to provide a fire extinguisher adapted to be used in railway passenger coaches, cars, and the like, by means of which fires in stoves of the coaches are instantly extinguished in case of accident, and by means of which gas or oil lamps in the coaches are extinguished.

RAILWAY TIE AND RAIL FASTENING.—J. U. BEATTY, Arrow, Pa. The invention refers to railway ties and rail fastenings, and the object is to produce a railway tie having simple means for fastening the rails thereto, which will operate to hold the rails securely without the use of spikes or the ordinary fastening devices.

Pertaining to Recreation.

GAME APPARATUS. — J. CHABOTY, San Francisco, Cal. The object of the invention is to provide a simple and inexpensive game apparatus in the use of which each player strives to complete an incomplete subject-figure, picture or representation, by attaching members representing the parts missing from the subject, upon a blank support rather than directly upon the incomplete figure.

Pertaining to Vehicles.

VEHICLE-WHEEL.—G. H. GRUSS, Goldfield, Nev. The invention relates to improvements in wheels designed for use on automobiles or other vehicles and in which the outer rim or tire is secured to the hub by a set of spiral springs and a resilient cushion, whereby the vehicle upon which the wheel is used is relieved from all jar or concussion due to road obstructions, and whereby the normal life and efficiency of the wheel is materially increased.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Full hints to correspondents were printed at the head of this column in the issue of August 8th, or will be sent by mail on request.

(10831) V. F. asks: 1. Why is the core of induction coil made of small iron wires instead of one solid piece? A. The core of an induction coil is made of wire, and not solid, in order to prevent the whirling currents, called "Foucault" currents, which would travel round the core if they could do so. They would heat the core very greatly. 2. Is it the volts, amperes, or watts that make an electromagnet? A. Ampere turns produce magnetism in a coil. One ampere flowing once around a turn of wire is an ampere turn, and the voltage produced by a coil is proportional to the ampere turns in the coil. Hence a coarse wire is used of low resistance, so that there may be a large number of amperes flowing through it, and often many turns are put on, so that the ampere turns may be as great as possible. This applies to the primary winding. 3. Is there any relation between sizes of primary and secondary wires and increase in voltage of an induction coil? Where can I get a book which treats in a simple manner the subject of storage batteries? Also one telling of the process of refining crude petroleum? A. Treadwell's "Storage Batteries," price $1.75, is a good book; Bottone's "Management of Accumulators," price $1.50, is also to be recommended. A good book upon refining petroleum is Brant's "Practical Treatise on Petroleum," price $7.50. 4. It is a law in physics that in the magnetic lines of force, the direction of such lines at any point is a tangent to the curve at that point. What, then, is the direction opposite the middle of a bar magnet? Opposite the end? A. The same rule applies to determine the direction of the magnetic lines when the lines are straight as when they are curved. At the middle of a magnet the tangents coincide with the lines themselves, as they do also at the ends of the magnet. A straight line is a curve with an infinite radius.

(10832) M. W. H. asks: 1. What is the philosophy of salt causing ice to freeze and unite in summer (as in case of making ice-cream), and causing ice and snow to melt in winter? A. Salt does not cause ice to freeze in summer and melt in winter. That is very loose thinking. The ice and salt in the freezer melt at any time of the year. The cream in the inner can freezes because the heat which melts the ice in the outer box is taken from the cream in the inner can. The ice cannot get heat to melt itself from the outer air because the box in which it is is of wood, which is a non-conductor of heat. The inner can is of metal and so is a conductor of heat. The cream furnishes heat to the ice and is cooled and frozen by the process. Ice and salt will melt in the open air by taking heat from the air at any temperature above 7 deg. F. below zero. Below that temperature they will not melt. 2. Why does frost penetrate solid ground so much deeper (in the same locality) than it does loose, porous ground? A. Solid ground freezes better than porous ground because the porous earth contains air. Air is one of the very best non-conductors of heat, and keeps the heat in the earth. 3. Why does frost penetrate a wall 12 inches thick (solid) sooner than the same thickness of wall with an open space in it, say, for instance, 6-inch wall, 3-inch space, then 6-inch wall, there being no way to moderate the temperature between the two 6-inch walls—or even a 12-inch wall with a 2-inch air space in it? A. The air space in a wall acts just as the air spaces in the porous ground do in the last question. It prevents heat from passing, and thus houses are built with air spaces in the walls to keep them cool in summer and warm in winter. Double windows are used in cold regions for the same purpose. 4. Would the explosion of a compressed-air tank be as dangerous to life and limb as other explosions, say, for instance, steam (outside of being scalded) or other explosives such as powder or dynamite? If there be a difference what is the nature of it? A. Air at the same pressure as dynamite will produce as destructive effects as dynamite. It is difficult to imagine any method by which this can be brought about. 5. As everything in nature has a cause, what causes the wind to blow (hard or easy); also what causes it to change sometimes half a dozen times a day, apparently in the same temperature (hot or cold)? A. Wind is produced by the heat of the sun, and always blows from a place of higher barometric pressure to one of lower pressure. This place may be in the next field in a summer day, and it may be hundreds of miles away. The wind rarely travels in a straight line for any considerable distance, but swerves and changes its direction as you state. 6. At what height in a heated room is the most stagnant air, consequently the most unhealthy and germ-bearing atmosphere? A. No height can be given for the worst air in a room unless it be at the ceiling above. Currents quickly diffuse the bad air to all parts of a room.

NEW BOOKS, ETC.

LIGHT WAVES AND THEIR USES. By A. A. Michelson, Professor of Physics at the University of Chicago. Chicago: The University of Chicago Press, 1907. Pp. 166; octavo. Price, $1.63.

Prof. Michelson, whose brilliant work in optics earned for him one of the Nobel prizes, has gathered in this volume eight lectures on light, delivered in 1899 at the Lowell Institute. Although thoroughly scientific in the discussion of the subjects of "Wave Motion and Interference," "Comparison of the Efficiency of the Microscope Telescope and Interferometer," "Application of Interference Methods to Measurements of Distances and Angles," "Application of Interference Methods to Spectroscopy," "Light Waves as Standards of Length," "Analysis of the Action of Magnetism on Light Waves," "Application of Interference Methods to Astronomy," the lectures are primarily directed to those who wish to have the phenomena of light explained to them clearly and accurately and yet without the aid of too much mathematics. In attaining that object, Prof. Michelson has succeeded admirably. The subject of the "Velocity of Light" might well have been expanded into an entire lecture; for the author is more competent to discuss it than any other American physicist, inasmuch as he recently made a new determination of light velocity by an improved method of his own.

MAGIC SQUARES AND CUBES. By W. S. Andrews. With Chapters by Paul Carus, L. S. Frierson, C. A. Browne, Jr., and an Introduction by Paul Carus. Chicago: The Open Court Publishing Company. London Agents: Kegan Paul, Trench, Trübner & Co., Ltd. 1908. 8vo.; cloth; 199 pages. Price, $1 net.

The curious and manifold characteristics of magic and cube squares receive a very thorough discussion in this work. What may be called the symmetry of mathematics is illustrated by the most peculiar and intricate combinations, which leave out of view but few examples of interest in the past field of magic numbers and include some original methods of construction contributed by the author himself. The building of a square in which all the numbers add the same amount in each horizontal, vertical or corner diagonal column, and which problem may be expanded into cubes, is plotted in scores of arrangements running from 9 to 729 cells or places, and wherein each case permits of beautiful and extensive variations, exhaustively explained in a way that should make the subject popular. About one-half of the volume contains chapters on the Benjamin Franklin squares and reflections on magic squares, by Paul Carus; the mathematical study of magic squares by L. S. Frierson; and magic squares and Pythagorean numbers by C. A. Browne, Jr.

PRACTICAL INDUCTION COIL CONSTRUCTION. By John Pike Loud. Percival Marshall & Co. 18mo.; pp. 128. Price, 50 cents.

This is No. 8 in the series of Marshall's "Practical Manuals," and is a handbook of constructive details and workshop methods used in building and repairing modern spark coils. The subject matter of this book appeared first in the pages of The Model Engineer and Electrician.

A VEST-POCKET HANDBOOK OF MATHEMATICS FOR ENGINEERS. By L. A. Waterbury, C.E. New York: John Wiley & Sons. London: Chapman & Hall, 1908. Vest-pocket size; morocco; vi+91 pages; 61 figures. Price, $1 net.

This pocket edition comprises sections on algebra, trigonometry, analytical geometry, calculus, theoretical mechanics and mechanics of materials, and most of the matter was procured from leading sources. Those who have studied or are studying the branches of mechanics generally taught in engineering courses, will find it a reliable and convenient reference book.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending August 11, 1908.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid from chromatic sulfate, electrolytically producing chromic, Adolph & Pietzsch 895,930
Acyclic machine, J. E. Noeggerath 895,887
Adding machine, F. R. Piper 895,678
Air cooling apparatus, C. Chase 895,962
Air ship, O. C. Olsen 895,672
Amusement car handling device, A. F. Biavati 895,946
Amusement device, H. A. Bradwell 895,951
Anchor of submarine or submersible boats, M. Laubeuf 895,648
Annealing box, W. B. Bennett 895,415
Anvil, vise, and drill, combined, C. Brewer 895,953
Arch and ankle support, L. J. Courteau 895,539
Artist's work rest or holder, J. C. Dana 895,972
Ash receptacle, T. L. Bristol 895,420
Automatic furnace, J. E. Jones 895,764
Automobile construction, W. Morrison 895,661
Automobile tire detachable rim, R. E. Jeffery 895,763
Automobile transmission gearing, G. I. Mitchell 896,034
Awning support, J. C. McNamara 895,578
Axle lubricator, F. L. Husted 895,567
Bag, J. E. Cornell 895,435
Bag holder, J. Hulbert 895,759
Batteries and electrolytic apparatus, construction of, F. A. Decker 895,732
Battery grid casting machine, J. A. Smith 895,902
Bearing, ball, N. N. Shaiduroff 895,901
Bearings, making annular, S. S. Eveland 895,992
Bed, Williams & Selby 895,526
Bed latch, tiltable, N. C. Merrill 895,571
Bed spring supporting frame, C. P. Trimble 895,602
Belt, electric, V. Sence 895,506
Belt fastener plate having beaded or rolled edges, Bull & Jackson 895,424
Belt guide, Gans & Ackerman 895,447
Bicycle and tandem frame, convertible, C. O. Hedstrom 895,753
Binding post, Babcock & Reuter 895,714
Binding post, M. Guett 895,747
Bit. See Driving bit.
Block molding machine, R. B. & W. W. Bennett 895,414
Block molding machine, O. Benson 895,614
Block signal, electric car recording, W. J. Murray 895,575
Boiler tube sheet, G. H. Rhoutan 896,045
Bolt anchor, O. Kohnstamm 895,769
Bonding clamp, B. B. Ladd 895,646
Books, telephones, and the like, support for, S. W. Benson 895,536
Booth, C. J. Burton 895,538
Boring tool, M. Mayer 895,778
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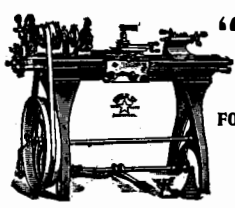

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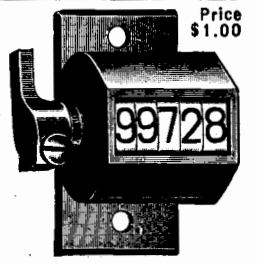

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Wrench, C. M. Andersen 895,712
Wrench, W. Muller 859,882
Wrench, H. C. Saunders 895,896
Wrench adjustable support, ratchet, J. Lang 895,647

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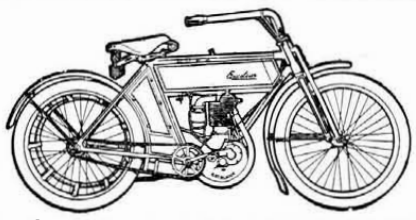

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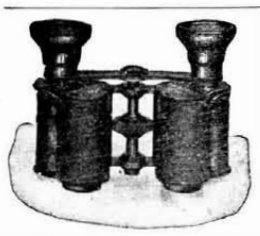

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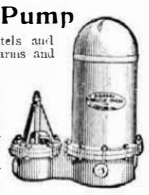

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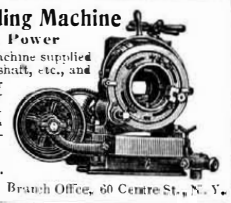

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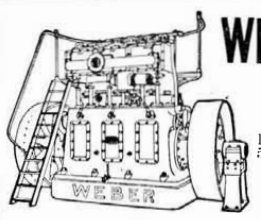

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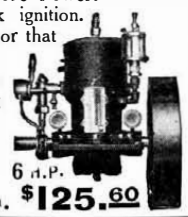

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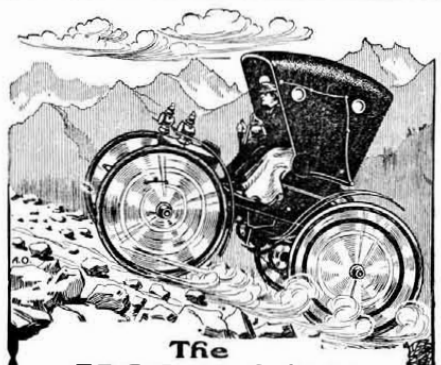

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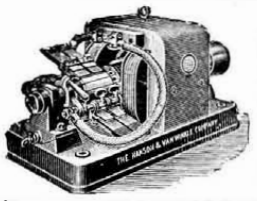

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